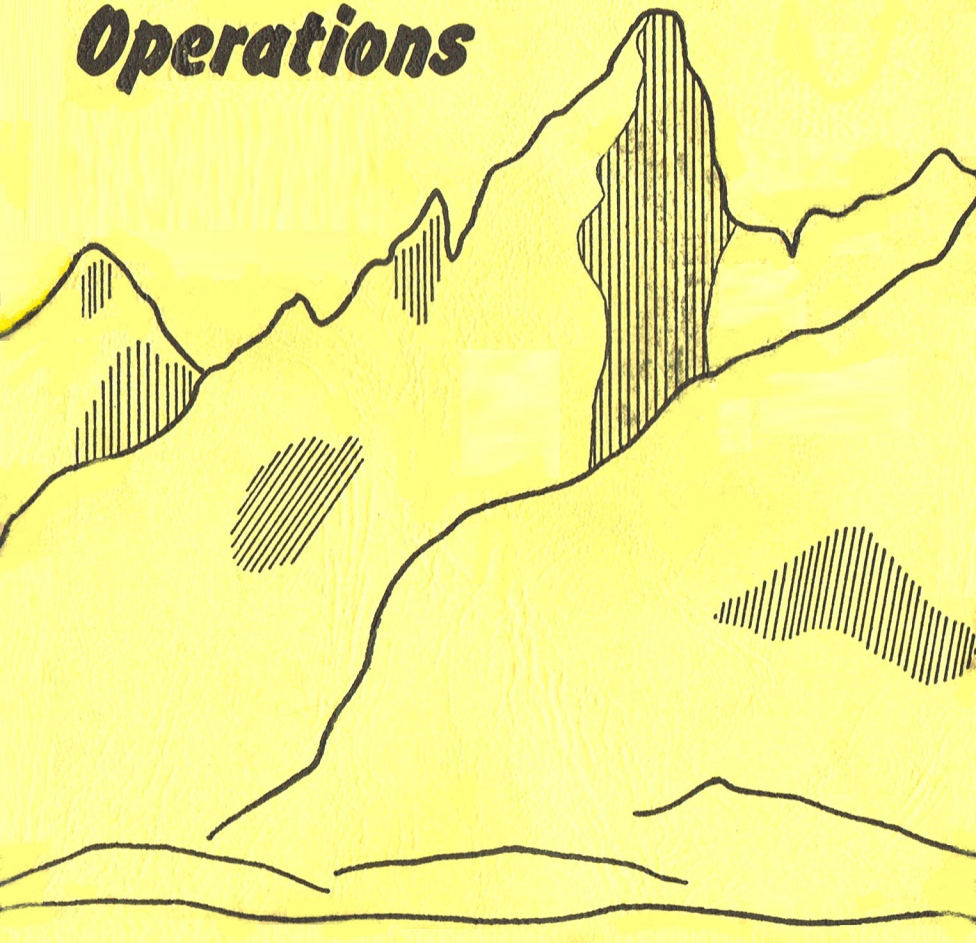
Mountain Search and Rescue Operations



Mountain Search and Rescue Operations

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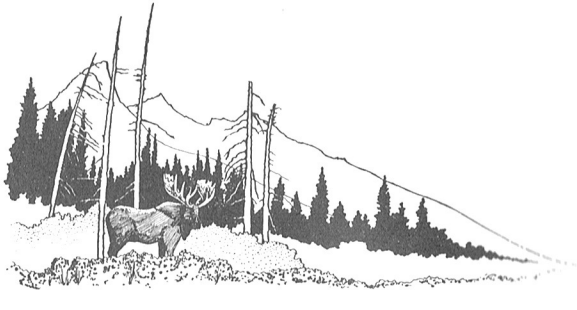

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Since little has been written on the subject of mountain search and rescue operations, this volume is original in many respects. It represents the cumulative experience, ideas, and thinking of men who have successfully used the procedures and techniques described.

All who contributed to this handbook hope it will prove of value to those who respond to mountain emergencies.

The Editor

MOUNTAIN SEARCH AND RESCUE OPERATIONS

Acknowledgment

This handbook was prepared by the Division of Ranger Activities of Grand Teton National Park. Technical material was prepared by Supervisory Park Ranger F. Douglas McLaren, Park Ranger John C. Fonda, and Seasonal Park Ranger Richard M. Emerson. Jean Fonda contributed the illustrations. Former Superintendent Otto M. Brown, Crater Lake National Park, provided data on search operations. Editing was by the late Ernest K. Field, Midwest Region, National Park Service.

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PART I

MOUNTAIN RESCUE OPERATIONS

CHAPTER 1 INTRODUCTION

Interest in the adventurous activity of mountaineering is increasing throughout the United States and is amplifying two major responsibilities of protection personnel, these are the prevention of mountaineering accidents, and mountain search and rescue operations. The latter responsibility is the subject of this handbook.

Mountain rescue operations pose protection requirements of an unusual degree of importance. The rescue of an injured climber from a high peak under difficult and dangerous topographic and weather conditions is the most arduous, exacting, and hazardous of all protection operations. In fulfillment of the responsibility of mountain rescue, the organization of competent rescue teams should be encouraged and plans developed for (a) the employment of experienced personnel, (b) the acquisition of required equipment, (c) the development of a mountain rescue plan, and (d) the establishment of a progressive training program for permanent and seasonal protective personnel.

Although every effort may be made to prevent mountaineering accidents, this in no way justifies the neglect of training in search and rescue operations.

This handbook is not a mountaineering training handbook, rather it is intended to be an aid in planning, organization, and execution of mountain rescue operations. It assumes basic mountaineering knowledge on the part of its readers.

CHAPTER 2 PLANNING

Certain protection requirement data should be accumulated to guide protection planning. These requirements may be determined as follows:

1. An analysis of the characteristics of the climber covering his average experience and ability, his knowledge of local climbing conditions, and his affiliation with mountaineering organizations;

2. An analysis of the frequency of climbs on the various peaks and routes;

3. A review of past accidents or incidents causing injury, fatality, or search and rescue operations;

4. An analysis of all natural or induced hazards such as snow and ice conditions, rock fall and avalanches, rock characteristics, lightning, exposure, storm occurrence, and fixed aids to climbing; and

5. A study of the important time and distance factors as they relate to climbing and rescue operations.

An appraisal of these requirements will form a solid basis for search and rescue planning operations.

In mountainous areas, as well as those embracing steep cliffs and canyons, protection requirements of mountain rescue must be studied before a rescue plan may be developed. The details of the plan will be based on the requirements and may be concerned only with limited climbing on readily accessible canyon walls, or may be geared to a full and intensive use of many high altitude and precipitous peaks and maximum difficulties of topography and weather.

Individual plans should include an operational outline for each type of eventuality from a critically injured climber at an almost inaccessible location on a high altitude peak under adverse weather conditions to an uninjured climber stranded in a readily accessible and nontechnical area under good weather conditions.

Mountain rescue planning must provide for:

1. The recognition of all conditions under which a rescue operation may be necessary;

2. The availability of qualified personnel to effect these operations;

3. The availability of all equipment and supplies necessary to effect any rescue operation required;

4. The implementation of more than one rescue operation at any given time;

5. A progressive training program; and

6. Continued emphasis on the prevention of conditions necessitating mountain rescue operations.

The most essential element of planning is a recognition of the need for qualified personnel. The success of mountain rescue evolves about the individuals participating in the actual efforts made to reach the injured climber and bring about his safe evacuation. A team of strong, experienced, and well-trained mountaineers is the backbone of any rescue plan, and without these men, no plan will succeed.

This phase of protection is important enough to justify the employment of permanent personnel who are qualified mountaineers, and to augment the permanent protection staff with as many other qualified seasonal personnel as required. These seasonal men should be encouraged to return during successive summers to build up and otherwise maintain the degree of training and experience of the rescue team.

CHAPTER 3 ORGANIZATION AND TRAINING

A mountain rescue plan should recognize the need for three leaders.

The organizational leader is the person who places the rescue plan into operation as circumstances warrant. He usually remains at headquarters or at a base camp and keeps in radio contact with the rescue team.

The rescue team leader is in charge of the actual rescue operation and leads the team members to the scene of the accident and supervises the evacuation.

The support team leader is in charge of the support team usually required to "back up" the rescue team and relieve this team of further arduous duties when non-technical terrain is reached.

When the rescue team and support team join, both teams fall under the direct supervision of the rescue team leader. The organizational leader usually makes no effort to supervise the action of the rescue team after they are dispatched but coordinates support operations and plans for additional emergencies.

Principal organizational requirements are the acquisition and classification of personnel into teams. These teams should consist of a minimum of six men each and be classified as to their capabilities with the most experienced group being considered as the "top" team. The other teams are identified with the type of operation for which they are qualified.

Training should be planned and conducted on two levels - one to train men in mountaineering techniques and the other in training qualified men in rescue techniques.

Equipment requirements must be fully met and such equipment and supplies maintained in immediate readiness and used for no other purpose.

Training in mountaineering and rescue techniques should be carefully planned and conducted in a progressive manner. Personnel with known experience and ability should receive training to increase their ability while less experienced men should be presented basic techniques.

In selecting personnel to receive training, the organizational leader should carefully screen potential team members. This screening should eliminate those men who have neither the willingness nor desire to participate. During the screening and initial training, the intangible mountaineer's attitude will manifest itself among the trainees to varying degrees. This attitude will be recognized and will further assist in selecting team members.

In areas with limited staff, each physically fit member may be required to participate in some manner in the rescue organization.

Teamwork in rescue operations is of primary importance and the confidence of team members in each other's ability should be developed through training and practice. In advanced operations, team members' lives routinely rest with each other's capabilities.

CHAPTER 4 GENERAL MOUNTAINEERING

The purpose of this chapter is not necessarily to instruct in mountaineering techniques but rather to describe certain techniques and precautionary measures as they apply to safe rescue operations.

I Precautions

While mountaineering is generally considered a hazardous activity, the mountaineer is not seeking danger. Mountaineering techniques are developed and practiced to reduce or avoid the natural hazards involved. Perhaps the most important precautionary measure is an understanding and appreciation of the hazards themselves, particularly those which are least apparent.

Where rescue work is concerned, mountain hazards are usually amplified over those encountered by recreational climbers. A rescue party is not free to select its weather conditions; the probability of rock fall is increased for large parties; the range of route alternatives may be greatly restricted; the amount and weight of equipment required to be carried is excessive; and the party is faced with maximum fatigue factors.

The degree of mountain hazards is relative to the experience and ability of the mountaineer. A given situation may be considered to be extremely hazardous by one climber and rather safe and routine to another. With this in mind, leaders of rescue teams should recognize and understand the limitations of the other members of the team and plan his actions accordingly. The compounding of an already tragic situation by the injury or death of a member of the rescue team must be avoided.

It is known that most accidents occur during the descent and may be caused from reduced caution on the part of the mountaineer due to fatigue and the psychological letdown after the summit has been reached with the feeling that the descent is an anticlimax to the ascent. It is also known that climbing downward often is more technically difficult than ascending, and rappelling and glissading accidents are more likely to occur.

There are two natural hazards in mountaineering over which the climber has little or no control. These are the

danger from natural rock fall and sudden adverse change in weather conditions including lightning.

A. Danger from Rock Fall

Safe climbing requires an ability to predict with some accuracy where a rock will fall from, when it is most likely to fall, and the course it will take if it falls. In addition, the climber must know how to handle himself when a rock is falling both for his own protection and the protection of others.

Rocks often fall as a result of erosional processes. Under alpine conditions, the primary process is frostwedging. Snow melting during the heat of the day forms water which flows into small cracks. As the sun leaves the slope, this water freezes and expands, widening the crack. This process continues until a piece of the mountain falls away. The freezing process may do one of two things when a block is ready to fall - (1) it may force it loose from its last holding surface, in which case it falls at the time of freezing or (2) it may cement the rock in place, in which case it falls at the time of next melting.

Notice that the conditions described above progress in terrain containing water from melting, and rocks which are fractured. Add alternate freezing and thawing and rock fall must be expected from such areas at the time of freezing and thawing. Such areas may be detected in many cases by signs of previous rock fall - talus slopes below and rock scars in the couloirs and on lower snow fields.

Most falling rock encountered on climbs is started by some person pushing, pulling, or kicking the rock. Most climbers will realize this when they are climbing over loose rock but not all climbers take proper precautions. First, it must be realized that loose rocks are found in otherwise solid areas, and hand holds and footings should be tested before weight is put on them. Second, a climber should judge his footing not only to prevent himself from slipping but also to avoid rolling rocks onto those climbing below. He will observe that most rocks are kicked loose when the back foot is lifted. He must train himself to be conscious of what his feet are doing at all times. Rocks may also be dislodged by the climbing rope between climbers and by wind action.

When a rock falls, its course is governed primarily by gravity and the shape of the mountain. It is obvious that falling rocks will not stay on the ridges and hence such high ground provides relatively safe climbing. It should be equally obvious that rocks will seek and follow the gullies and couloirs and that, whenever possible, climbers should not. This requires comment here only because couloirs so often tempt a climber. They provide obvious climbing routes at a lower angle than the surround-terrain, and careful judgment is required in route decisions at such points. Couloirs cannot be avoided all the time. When the route chosen does involve a couloir, it is essential that the party follow one edge or the other, avoiding the center where rocks are most likely to fall.

One important rule applies here and elsewhere - large parties must be managed to prevent one person from climbing in the "fall line" of another person. The fall line is straight down the slope - the line of gravity. If a party of ten selects a route up the center of a couloir, every man is climbing in the fall line below every other man. A rock falling from higher on the mountain, or loosened by another climber, endangers the entire party. It is advisable when such conditions must be encountered, the party close interval so that rocks rolled from ascending climbers do not gain excessive momentum before they strike a climber following.

A climber who knocks or pulls a rock loose, should call out loudly "rock." He should do the same if he sees one falling, and not supplement this call with any other words such as "look out." It often embarrasses a climber when he kicks a rock loose and he may wait to see if it is going to stop or roll free before calling "rock." By all means, he should put pride aside and give warning immediately, rather than compound an accidental or careless rock fall with an act of poor judgment. When a climber hears the warning cry or sees a rock falling he should first locate the falling rock and watch it, trying to determine its course. At the same time, he should size up his location with respect to cover. He should wait until the falling rock's course is determined and then seek cover. If no cover is available, he should wait until the rock is nearly upon him and then dodge, watching the rock all the time. The climber should control his actions carefully and not make unreasonable and dangerous efforts to escape a rock which may not strike in his vicinity. One's head is

extremely vulnerable to falling rocks. "Hard hats" should be worn at all times.

B. Storms and Lightning

Since rescue operations cannot be postponed because of weather, the possibility of undertaking such operations during storms is increased. Sudden storms may produce lightning, rain, snow, ice, wind clouds, and reduced visibility. Rescue operations may be greatly complicated. Once engulfed in such a storm, the climber is likely to be as much at the mercy of the mountain as he will ever find himself. During lightning storms, high points, pinnacles, and ridges are to be avoided. If the party is free to move it should descend into gullies, saddles or couloirs. When in the heart of the storm, with lightning striking close at hand, movement is not advisable when the terrain is technical. Climbers must be secured during lightning storms. A climber, if he is not secure, may be momentarily stunned by a strong charge from a lightning strike nearby and suffer a fatal fall. The best procedure is to stop in the most convenient and safe location away from prominent elevations. Rope up if previously unroped and anchor the party to the mountain where necessary. Place metallic equipment away from the party or off one's person. Squat on the soles of boots and if possible avoid touching rock or other persons until the storm subsides.

The degree of difficulty in climbing may be drastically changed by sudden severe weather. A relatively simple climb may become exceedingly difficult through the formation of ice on rocks and otherwise wet and freezing conditions. During such conditions, unusual efforts must be maintained to safeguard the members of the rescue team.

C. Climbing on Snow and Ice

The dangers encountered on snow and ice are often less obvious and more often underestimated than those involving rock. One of the leading causes of mountaineering accidents is the underestimation of snow fields by inexperienced climbers. Snow fields should be avoided by climbers who are not qualified either by experience or equipment to negotiate these areas. The climber should be experienced and equipped with an ice-axe before starting a glissade on a steep snow field with rock

outcroppings, no out-run, or with protruding rock walls.

When snow recedes during the summer months, undercut areas and hollows form around the edges of the snow field and around rocks protruding through the surface. A climber may be seriously injured in breaking through a thin crust in these undercut areas. Since snow fields are frequently used by rescue parties, particularly in the descent, it is essential that each member understand the correct and safe climbing procedures on snow and ice.

II Mountain Walking

Since mountain walking usually consumes about 90 percent of the expenditure of time and effort in reaching the scene of an accident, certain fundamental principles should be understood by each member of the rescue team and the support elements.

The technique of mountain walking involves a steady, rhythmic pace. Place each foot flat on the slope to gain maximum friction and keep the body weight directly over the feet. Relax the leg which is in motion as much as possible and lock the supporting leg permitting the bone structure to take most of the weight and relax the muscles. Whenever possible, step over or around obstacles rather than on top of them.

Breathing during the ascent should be as natural as possible. Do not hesitate to breathe heavily if you are so inclined and attempt to correlate respiration with pace, inhaling and exhaling at regular intervals.

Pace of the rescue party must be governed by the man with the heaviest load. It is the leader's responsibility to set a slow, even pace which covers ground with a minimum loss of energy for each man. The heaviest loads should be toward the front of the column and each man should endeavor to keep a uniform interval between himself and the man ahead. If gaps develop in the column, the men on the end will find themselves alternately stopping and rushing ahead. Periodic rest stops should be short in duration.

The normal humanitarian tendency to make all possible speed is commendable but members of the rescue team should not expend all their energies in over-extending themselves to reach the scene of the accident. Much hard work will

remain to be done in the evacuation of the injured.

Terrain peculiar to mountain walking may be classified as talus, scree, grassy slopes, and hard-packed ground.

Talus is a generally large group of variable sized boulders formed through mass wasting whereby rock falling from cliffs accumulates in cones lining the sides of the valley. Talus is often loose and care must be exercised in moving over it. Carrying a loaded litter across a large boulder talus slope is arduous.

Scree is talus in a finer graduated form. Scree slopes should be avoided as much as possible on the ascent but may be utilized very effectively on the descent.

Grassy slopes will usually be made up of small hummocks rather than one continuous field. The weight should be placed on the upper side of each hummock when crossing side hill areas. Subalpine slopes supporting dense shrubby stands of trees and brush should be avoided whenever possible.

Hard-packed ground offers no particular technical problem. Pace is again the most important factor and must be consciously regulated because of a tendency to hurry over easy ground. Steep slopes may be traversed in the ascent in zigzag or switchback fashion.

A worthwhile precaution in any mountain walking or climbing situation is to avoid stepping on smooth rock slabs or slopes on which there is a thin layer of sand or gravel. This material acts as "ball bearings" and may cause sudden and serious falls.

III Routes and Route Selection

Route evaluation and selection is a highly important technique acquired through mountaineering experience. It is probably the most essential attribute of the mountaineer and delineates leadership qualities. The leader is the route finder and must select the route to meet the capabilities of the team and the other variable factors of the rescue requirements including weather conditions. Usually, the route selected will be the one used by the distressed party (the object of the rescue operation), although it is quite possible that an alternate route may

be used to a better advantage.

Some of the considerations in rescue operation route selection are listed:

A. Safety of rescue team from: Rock fall and avalanches; unnecessary high-angle exposures; unnecessary technical rock work; and unnecessary fatigue.

B. Time-saving measures to include: More direct routes; probable pace possible on different routes; and the avoidance of dense brush and slow conditions.

C. Communication with: Scene of accident; support party; and headquarters.

D. Evacuation routes to be used: May be different from route used to reach scene; may pose special problems to reach from scene of accident; should make maximum use of scree and snow fields; and should avoid traverse conditions.

E. Equipment should be carried and used to meet the route requirements; and/or the party should select the route for which equipment is available.

Much information available to the leader regarding the location of the accident and extent of injuries is vague at best. He is not always certain of the location of the injured climber and less positive that the injured will be there when his party arrives at the scene. In many cases rescue parties have met the injured climber much lower on the mountain than the reported location of the accident. In such situations the injured usually has been assisted down the mountain by other climbers in his party. This points up the general wisdom of the rescue party leader choosing his ascent route to coincide with the most likely route of descent of the injured.

IV Use of Equipment

Every member of a mountain rescue team must be familiar with certain items of equipment and their proper use. In most alpine regions this equipment will include the climbing rope, pitons, karabiners, and associated hardware, crampons, and the ice-axe.

A. Rope Management

Of all the equipment techniques required in climbing and rescue operations, rope management is the most important. In few, if any, other outdoor activities does a person's life literally "hang by a thread." In many phases of advanced mountaineering, the climber's life very certainly rests on the rope he is using and the knots that he has tied. During rescue operations the lives of from two to four members of the team may rest upon one rope. The rope, therefore, should receive due care and attention.

Good rope management will save a great deal of time and considerable wear and injury to the rope. Listed are some of the points which should be observed:

1. Prevent the rope from becoming damaged.

At best the rope receives hard use; it is subjected to heat, cold, water, freezing, and alternate tension. Each time the rope is used it receives abrasion and fiber damage. Cuts and bruises by falling rocks cause the greatest injury to climbing ropes and each team member should make every effort to protect them from this damage. Examine ropes periodically to determine the extent of mechanical damage. Discard any rope that has been subjected to an unusual tension or excessive fiber damage and do not use it again for mountain climbing operations.

2. Prevent the rope from catching on rocks and brush.

The ends of a nylon climbing rope are best secured by wrapping tightly with thread and melting the fiber ends with heat. Do not use end braids, adhesive tape or knots of any kind. Make the middle mark with colored dye, not tape.

Never permit a knot to form or remain on the rope.

When roped up and climbing continuously, always take up the slack rope between yourself and the man ahead maintaining a straight line by taking in coils. This prevents loops of rope from dropping behind or otherwise catching on rocks. When climbing on snow, keep the rope off the snow as much as possible.

3. Prevent the rope from snarling.

Keep ropes coiled by standard methods. In coiling the rope, take care that all coils are the same size and not twisted into figure eights.

When several ropes are uncoiled in one small area, which is often the case in rescue operations, keep the ropes separated and piled or coiled. Know where each rope-end is, to which rope it belongs, and what that rope is doing or how it is to be used. Colored ropes are valuable in certain operations.

When preparing to pay out rope, as in lowering a stretcher or roping up to climb, untie the coil and completely uncoil it, starting at one end and piling the rope until the running end is reached. Do not try to belay by feeding the rope out from a standard coil.

When coiling or piling a rope, select a spot free from loose rock, brush, and similar obstructions which will interfere with the operation.

When throwing a rope down for rappel purposes or other reasons, the rope generally snarls part way down unless proper precautions are taken. Do not attempt to throw a standard coil, or feed one end down. The best procedure is to recoil the rope completely using small coils about 18 inches in diameter with coils placed so they do not overlap one another. The top end should be secured and the coil thrown straight out and flat with no twist or spin so the coils slip out one at a time.

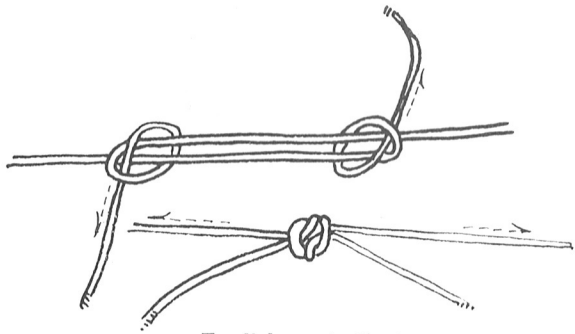
In summary, good rope management is required for efficient climbing and rescue work. It can be achieved only if each member is at all times aware of what each rope is doing, where each rope leads, and what, or whom, is on the end of each rope. Each member should be thoroughly familiar with rope stress limitations.

B. Knots

Knots used by climbers fall into four classes: (1) knots used to tie the ends of two ropes together; (2) knots to tie the end of a rope to any object; (3) knots to tie the middle of a rope around any object; and (4) special knots.

In general, knots should not reduce the strength of rope appreciably, should be easy to tie, and should be easy to untie after they have been subjected to strain. Knots tied on nylon ropes tend to slip because of the smoothness of the nylon fibers, thus every knot should be carefully tied and tensioned and secured with two half hitches firmly drawn.

1. Knots used to tie the ends of rope together include the Englishman's knot (fisherman's knot), and the double sheet bend. The most "bombproof" knot is the Englishman's knot (pictured below) with the short free ends secured with half hitches.

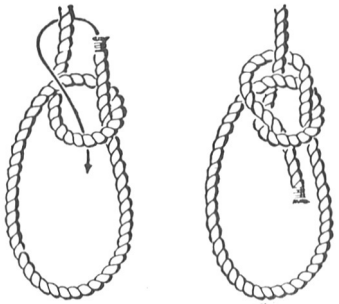


Englishman's Knot

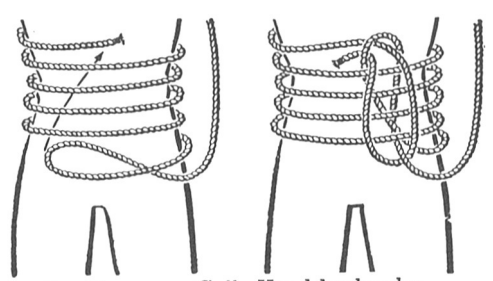
The editor has taken the liberty of using the more appropriate term "Englishman's knot" which is correct and probably predates the term "fisherman's knot."

2. The primary knot used to tie the end of a rope to any object is the bowline knot. This is the classic mountaineer's knot. It is used to tie the end man into the climbing rope and in any other situation requiring a loop knot at the end of a rope. It has an efficiency of about 65 percent, is easy to tie, and is easy to untie after tension has been applied. The bowline on a coil is a valuable knot and may also be used to tie end men into the climbing rope, particularly when seat loops are required. This knot is also used to form an adjustable triangle for stretcher suspension.

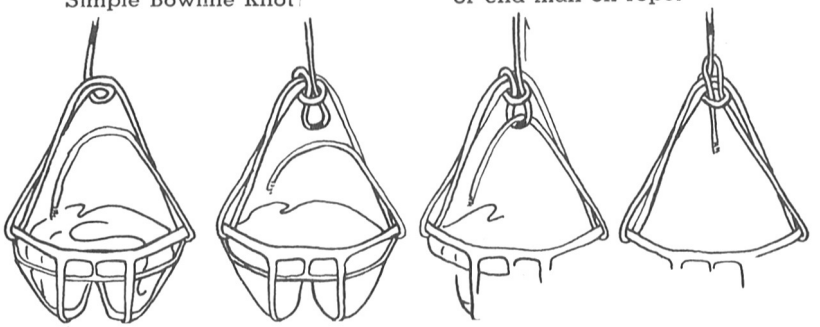
The following sketches illustrate how these knots are tied and may be used.



Simple Bowline Knot

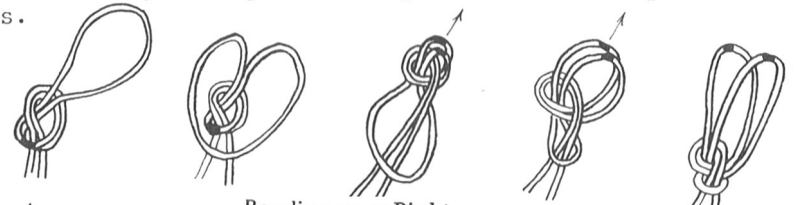


Bowline on a Coil. Used by leader or end man on rope.

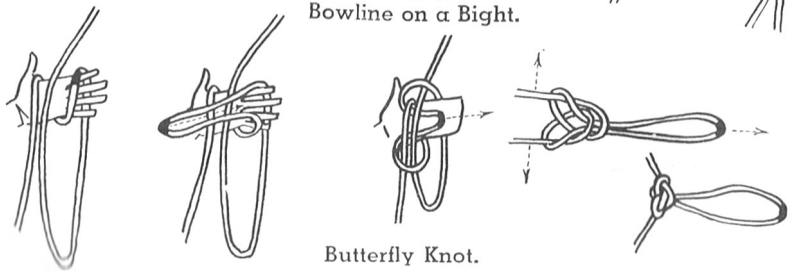


Bowline on a Coil. Used to provide adjustable triangular tie to stretcher.

3. Knots used to tie the middle of a rope around any object include the butterfly knot, the figure eight loop, and the bowline on a bight. The bowline on a bight is a very strong knot and provides two independent loops.

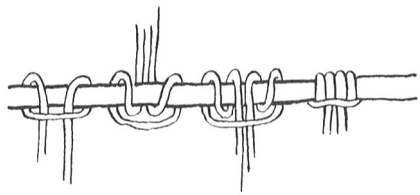


Bowline on a Bight.



Butterfly Knot.

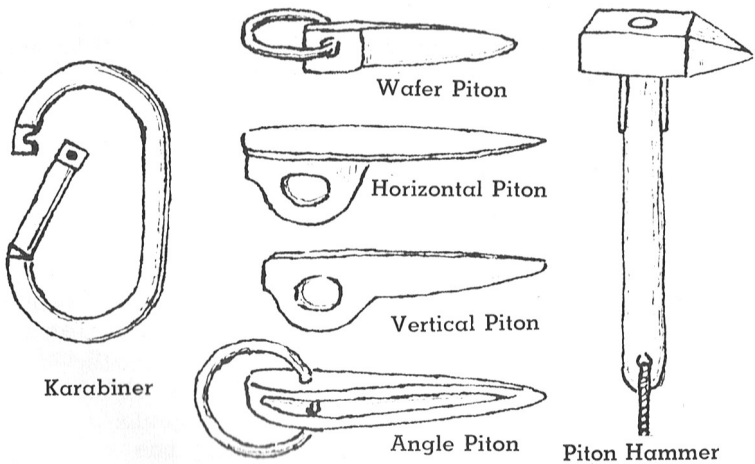
4. The most important special knot is the Prusik knot. This is a tension holding knot and has many valuable uses, particularly in rescue operations.



Prusik Knot.

C. Pitons, Karabiners and Other Hardware

Each member of the technical rescue party should carry a supply of pitons in the various shapes and sizes, a piton hammer, and a supply of karabiners. Karabiners particularly are a most useful item and an ample supply of these should be carried. Piton technique applied during rescue operations should consider the need for maximum strength and holding power. In many cases piton anchors are required to support greater loads than those encountered in normal climbing. Self-equalizing piton anchors frequently may be required. The use of sling ropes, properly and securely tied over natural rock features, often may be preferable to piton anchors and in some cases a combination rope sling and piton anchor may be desirable.



Experienced climbers realize that suitable cracks and crevices are not always available for pitons and point up the need for alertness on the part of the leader to take advantage of every possible piton or anchor point required and to have a suitable variety of pitons available to use in a wide range of cracks and crevices. Route selection may have to be altered somewhat to provide proper anchor and belay points for the rescue team. Under extreme conditions expansion bolts may be used to provide an anchor point which makes the over-all route possible. Expansion bolt sets have been developed which are light in weight and easily placed.

In general, pitons in place and not driven by the leader should not be trusted. Good judgment and experience on the part of the leader will determine if such pitons may be used. Do not compromise the safety of the team by using bent or otherwise damaged "second hand" pitons. If the piton has been bent or pounded out of shape in the process of its removal from the rock, it should be discarded.

Since a large number of karabiners are usually required for most rescue operations, it is desirable to use the duraluminum or alloy karabiners. These are light-weight, yet strong. The body of the karabiner should have a diameter of at least 3/8 of an inch.

D. Crampons and Ice-axe

Basic equipment for safe travel on snow and ice include the crampons, ice-axe, and ice pitons.

The accepted crampons have 10 or 12 prongs about $1\frac{1}{2}$ inches long, are made of forged steel, may be obtained in different sizes, and are usually imported. The American made pressed steel crampons are not desirable.

Through their knowledge of the location of accidents and the terrain to be negotiated, the organizational leader and rescue team leader will make the decision as to whether crampons should be taken on the mission. If they are taken, they should be carried in such a manner so the prongs will not cause discomfort to the carrier or damage other equipment. Usually, the bottoms of the crampons are placed together, bound between sheets of heavy canvas.

The crampons must be of the proper size to fit the boots of the members of the team and they must be securely tied to the boot permitting no movement between the boot and crampon. A loose, or poorly fastened crampon, is hazardous. Crampons should be used only on snow and ice fields and should not be used in crossing rocks and boulders.

When walking or climbing with crampons, there are two basic rules which should always be followed. First, all prongs of the crampon must make contact with the snow or ice at the same time. This rule implies that one must walk flat-footed, placing each crampon flat upon the surface of the snow or ice and flexing the ankles. One should never edge the foot in an attempt to gain purchase with the side of the boot or crampon. Secondly, the user of the crampons should always be conscious of the fact that he has them on his feet. The feet should be placed to avoid catching the prongs of the crampon in the trousers of the other leg. Snug fitting trousers at the ankles and lower legs reduce this possibility.

The ice-axe is a versatile item of equipment and has many important and specific uses in rescue operations.

In carrying the ice-axe, the climber should always keep his hand in the wrist loop and control the point and sharp edges so as to avoid injury to himself and his companions. If the axe is being carried by the shaft, it is usually desirable to hold the point end to the front to avoid injury to the man walking behind. When traversing a moderately steep snow field, use the axe as a cane for balance on the up-slope side. Grasp the head of the axe with the adz protruding from the thumb side of the closed fist. This facilitates self-arrest operations.

When the slope is steeper, it becomes difficult, tiring, and is less effective to use the axe in cane fashion on the up-slope side. Hold the shaft of the axe in the uphill hand and grasp the downhill hand over the head of the axe, again with the adz at the thumb, and use the point for balance on the up-slope side. If the snow or ice is extremely steep, reverse the hand positions and use the pick for balance on the up-slope side. Notice that in either case the axe is held in a "port arms" position and one hand is always grasped firmly about the head of the axe with the adz end protruding from the thumb side of the hand.

An important aspect of the ice-axe technique is proficiency at the self-arrest - a simple means of checking one's own fall on steep snow. Once having lost control and starting to slide, the climber maneuvers himself into a position on his stomach with feet downhill slightly spread to prevent rolling. Meanwhile, he has arranged the axe in the "port arms" position described above. The axe then is under his chest against the snow as he slides down the slope. His lower hand grasps the shaft near the point and his upper hand clenches the head of the axe firmly with the adz by the thumb. The climber can then gradually force the pick into the snow effecting a braking action. It is important that he not let the axe be pulled up above his head with his arms outstretched, for then the braking action is lost. He should not be too hasty in inserting the pick because the resulting sudden jerk may destroy his efforts to arrest himself. Above all, he should keep his upper arm cocked firmly down with the fist no higher than his shoulder.

Position of ice axe in self arrest.

A most important use of the ice-axe is in belaying or anchoring operations required in ascending, traversing, or descending steep snow fields. For this purpose, the shaft of the axe is thrust deep into the snow and the belay

rope is passed around the shaft just beneath the head of the axe.

The ice piton provides an effective belaying point in hard ice conditions. This piton, in one of its several forms, is driven deep into the ice and the rope passed through a karabiner which is snapped into the ring of the ice piton. A more effective and stronger anchor point may be effected by using the self-equalizing anchor principle through several ice pitons.

V Techniques

There are a number of excellent handbooks and manuals on mountaineering techniques. These have been prepared and edited by competent mountaineers and should be available in the area's library for reference and review by members of the mountain rescue team.

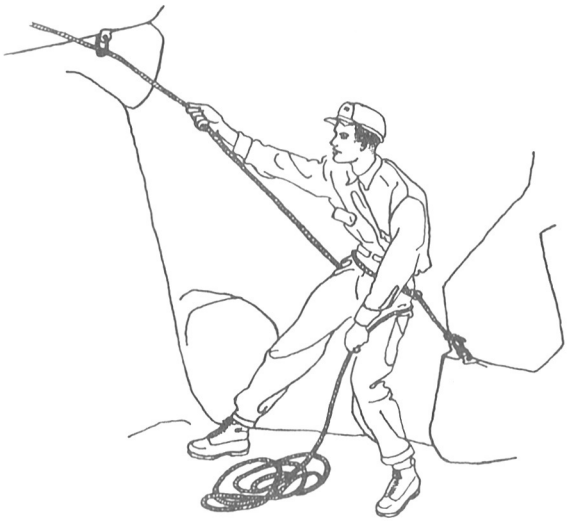
The discussion of mountaineering techniques in this section will only be concerned with belaying, rappelling, and rope signals.

A. Belaying

Proper belaying technique is the most important requirement of safe mountaineering and rescue operations. There are five links in the belaying chain: the human body; the climbing rope; the karabiner; the piton; and the rock. A complete knowledge of all the elements of the belaying chain must be understood as well as an estimation of what may constitute the weakest link.

For rescue operations, three basic types of belays are used: (1) the sitting hip belay; (2) the standing hip belay; and (3) the belay through pitons. One of the most important phases of belaying begins before the belay is put into operation, this being the selection of the belay position. The basic position used will vary according to terrain and requirements. Fundamentals, however, remain the same in all situations.

A good sitting hip belay position should provide triangular bracing for the legs. At least on leg, preferably both, should be braced in the direction of the anticipated fall or load. If the belay position is the least bit questionable, the climber effecting the belay must be securely anchored by either a piton or a sling rope.



Piton or upper belay for the protection of the leader. (Belayer tied in.)

Sitting hip belay.

Standing hip belay. (Belayer tied in.)

The climbing rope is run behind and along the small of the belayer's back. The section of rope which runs to the climber, or weighted end, follows along the most strongly braced leg. The hand which controls this section of the rope is known as the guiding hand. The other hand becomes the braking hand. When paying out rope or taking it in during any belay, the braking hand never leaves the rope or passes above the guiding hand. To stop the rope or hold a weighted stretcher, bring the braking hand across the chest or between the legs to increase friction. In some cases a small amount of slack may have to be run out before the rope can be stopped. The principles of the dynamic belay should be understood and practiced by all members of the team.

In situations where the topography does not afford space for a sitting hip belay, the standing hip belay can be used. If a load of any great proportion is anticipated, the belayer must be anchored. Again, one leg is braced in the direction of pull. The rope to the climber or stretcher is run along the small of the back and down the braced leg. Do not run the belaying rope over the shoulder. Braking the rope is accomplished by bringing the braking hand down between the legs.

Belaying through pitons is a critical technique. It is usually planned to catch the maximum strain developed from a leader fall. The dynamic belay must be used. When belaying through pitons, the belayer frequently is not able to see the climber. He must be able to feel the climber through the rope and judge his progress accordingly. Should the leader fall, the direction of pull will usually come from a piton above, which requires the belaying rope to run under the belayer's seat thus giving him greater control of the rope. If the rope is run along the small of the back and a pull comes from above, the rope will slip up the back making control extremely difficult if not impossible. It is advantageous for the belayer to maintain a standing position while belaying through an upper piton. He should also be securely anchored to the rock. In a standing position, the belayer can literally sit down on the rope when weight is applied on the running end. When belaying laterally through pitons, it is up to the discretion of the belayer as to the position of the rope about the body. The belayer should wear gloves in all positions and should be securely anchored to the rock wall.

Belaying on snow and ice is a technique which requires knowledge and experience in the amount of holding power which the snow or ice possesses. This can usually be determined by the difficulty by which the axe is driven into the snow or the difficulty of driving an ice piton into hard blue ice.

Whenever possible, snow should be utilized for the stretcher's descent. Late in the summer, hard ice is usually exposed as the surface snow on glaciers and other snow fields has melted. This makes evacuation work somewhat more difficult. Regardless of the time of year or the degree of angle of the snow slope, the stretcher must be belayed at all times while on snow or ice.

The most common type of belay for snow is the ice-axe shaft belay. The ice-axe is driven into the snow as far as possible and the belay rope is passed in a round turn about the shaft. The turn of rope which leads to the stretcher should be nearest the snow. Keep the "round turn" as low on the axe shaft as possible. Ideally, the axe head should be no more than six inches above the snow. Cut or kick a large step below the axe and stand with the lower leg braced downhill. Back up the axe with the upper knee and feed the rope around the shaft of the axe with one hand while holding on to the axe head with the other.

If the slope is steep, run the rope around the small of the back in addition to a turn around the shaft. The belay position now becomes essentially a hip belay with the shaft serving as a belay point. Generally speaking, the weight of the stretcher will be sufficient to make the rope feed itself. In some circumstances, however, the braking hand may have to serve as both "feeder" and "braker." In soft, firm snow check constantly to see that the rope is not biting down into the snow. The uphill boot may have to be placed beside the shaft of the axe to remedy this situation by allowing the rope to run over it.

Belaying on ice demands that the belayer wear crampons. Perhaps the most adequate belay for ice is the sitting hip belay anchored by either an ice piton, embedded boulder, or ice-axe pick driven firmly into the ice. While there are more refined types of belays for ice climbing in general, the sitting hip belay has been found to be best for belaying or traversing a stretcher across ice.

Ice axe belay procedure on steep snow.

In belaying on ice, the belayer first cuts a platform into the ice. The floor of the platform should slope slightly toward the inside, and the area must be large enough to provide the belayer with room for triangular bracing. After cutting the platform, the belayer then anchors himself to the ice with an ice piton. Ice-axe pick anchors are of questionable strength and should be used only as a last resort. Anchored firmly, the belayer then assumes the standard sitting hip belay. The belayer must advise the party below him, accompanying the stretcher, as to the amount of belay rope remaining. Before the end of the rope is reached, the stretcher party anchors the stretcher securely and prepares for another belay and anchor position.

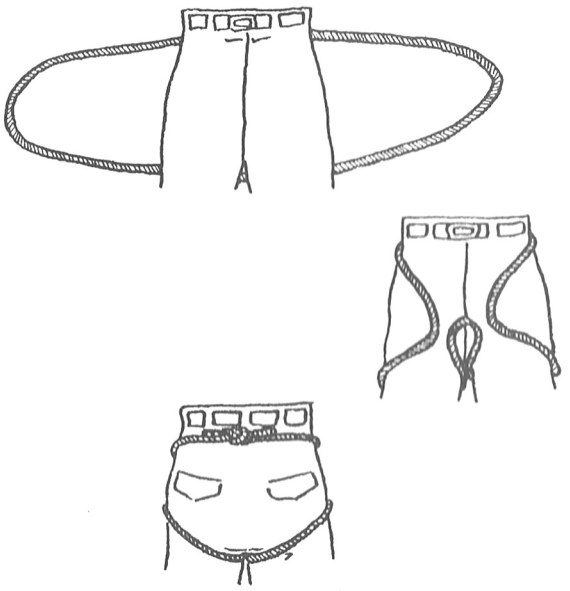
B. Rappelling

Rappelling or roping down is a standard means of descending a steep rock face or slab whereby the climber utilizes friction either around his body or through a karabiner to slide down a double rope.

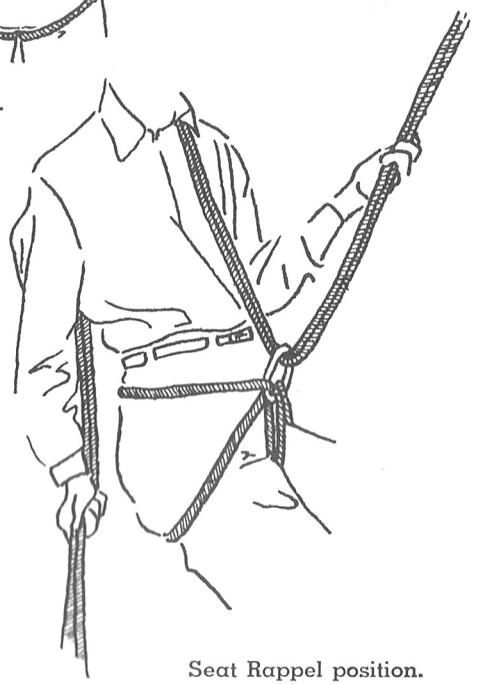
The rappel is frequently used in rescue operations to permit members of the team to descend to lower elevations to assist in the evacuation of the litter from precipitous areas and to establish new anchor and belay points. It is assumed that members of the rescue team involved in high angle operations will completely understand the various rappel techniques. Certain basic precautions are mentioned, however, as a guidance for safe operations.

The rappel anchor must be completely strong and safe. This anchor may be a tree, rock nubbin, or piton. Should a rope sling be used in connection with the rappel anchor, it is important that weight distribution between pitons be considered and the sling rope be long enough to provide an acute angle at the point to which the rappel rope is attached.

Rappelling should be effected in an even and steady manner, avoiding long "slips" and sudden braking. Alternate "free falls" and sudden stops while rappelling are stimulating but impose great strains on the rappel anchor and rope.



"Diaper" seat sling.



Seat Rappel position.

Other common sense requirements in rappel operations include the assurance that both ends of the rappel rope reach a suitable landing point and that the rappel route is free of loose rocks. The first man on rappel should assure himself that the route is clear and that the rappel rope may be recovered at the conclusion of the rappel.

C. Rope Signals

Voice contact is frequently impossible even between two or three persons tied to the same rope. After climbing around a point or corner of a windy ridge or when climbing in a storm, communication, which is so essential, becomes impossible unless the rope is used for signaling. Climbers, therefore, must be thoroughly familiar with the standard climbing rope signals, such as: "on belay"; "climbing"; "slack"; "tension"; and "up rope." He must be able to convert these from vocal to rope signals.

The following signal system is suggested. It is advised that it be used as a standard practice even when voice contact is possible. There are several instructional points concerning the use of this system. A single jerk on the rope is never used as a signal. There are too many situations which produce such a jerk unintentionally. The rope must be completely free of slack before a signal can be effective. Pull in all slack until you can "feel" the other climber, then give the signal jerks with sharp tugs. Appropriate caution must be used in giving these sharp tugs to avoid pulling a climber off balance. When providing an upper belay, rope should be fed out only when the signal for slack is received. Every signal has its answer. A signal should be repeated until the answer is given.

1. On belay. Two jerks.

This signal is given by the man who was climbing but now is in a position to belay the next climber. The answer: by two jerks.

2. Climbing. Two jerks.

This signal is given by the former belayer who has gone off belay and is now ready to climb. Answer: by two jerks.

3. Slack. One jerk, followed by a steady pull.

This signal is given by the man climbing to ask for slack rope. He must pull in his own slack. Answer: by giving slack as it is pulled.

4. Up rope. Three jerks.

This signal is given by the climber when his belayer has let too much rope accumulate, signifying that rope should be taken in. Answer: by taking in rope until the climber is "felt" on the rope.

5. Tension. Three jerks followed by a steady pull.

This signal is given by the man climbing, informing his belayer that he wants to use the rope to support weight. Answer: by taking in all rope available and holding firm until directed to do otherwise.

In an effort to keep this system as simple as possible, some common signals are dispensed with, i.e., "test" and "testing," and "off belay" are not included, which means that the leader must employ good judgment in the selection of routes and belay positions. There is no signal to inform the climber of the amount of rope remaining, again leaving it up to the leader to estimate his progress in selecting belay positions.

CHAPTER 5 EQUIPMENT

Mountaineering equipment requirements for rescue operations will include all or some of the following items. This may be used as a check list for area operations with needs determined by rescue requirements. For identification and visibility purposes, rescue equipment should be marked with yellow enamel as required.

A. Mountaineering Equipment

1. Rope. Only nylon rope should be used for mountaineering and rescue operations. In normal mountaineering operations, the 3/8 inch diameter by 120 foot length has been generally accepted as standard. For belay uses, however, where additional strength is required such as the lowering of a loaded litter with one or two extra climbers, the 7/16 inch diameter by 120 foot length is recommended. The use of colored ropes for identification is desirable in rescue techniques. All standard 120 foot ropes should have the ends securely fused by heat and the center of the rope marked with a red or yellow band. Sling ropes should be of 3/8 inch nylon and at least 15 feet in length. It has also proven desirable to mark the center of sling ropes as well as identifying the length of the sling ropes by end bands of colored dye or ink should different lengths be used. In some areas it has been desirable to acquire and utilize unusually long ropes for specific rescue operations. These ropes may be from two to four hundred feet in one continuous length and in either 3/8 inch or 1/4 inch in diameter. The mountaineer should thoroughly understand the load limitations of the various size ropes. He should understand elasticity factors, breaking strains, and rope sling angle requirements. Nylon webbing or nylon parachute shroud line should not be used in mountaineering operations.

2. Pitons. Piton requirements in the various areas will depend upon the type of rock on which they are to be used. Usually the horizontal piton is used much more frequently than the vertical piton. In any event, a good variety in numbers, shapes, and sizes of the various pitons should be accumulated and kept in readiness for rescue operations. The angle piton has proven valuable for maximum holding and strength requirements.

3. Piton hammers. Piton hammers may be secured in various sizes, shapes, and weights. Experience will

dictate the best size and type to use. It is important that the piton hammer be secured to the climber at all times. This may be accomplished by either a wrist loop of light nylon line or a neck loop which permits the climber to wear the hammer about his neck with sufficient line available to permit the hammer to be carried in one of the climber's pockets. It is important that the head of the piton hammer be securely fastened to the handle.

4. Karabiners. This item is also available in various shapes and sizes and strength. The karabiner should be made of stock at least 3/8 inches in diameter and preferably of duraluminum or alloy to cut down the weight of this piece of equipment. For unusual strength requirements, some of the special reinforced karabiners with, or without, a screw locking gate may be desirable.

5. Expansion bolt equipment. This equipment may be necessary in some operations where suitable belay or anchor points, or piton cracks are not available. Its acquisition and use will be governed by the experience of the local rescue personnel and requirements imposed by the terrain.

6. Crampons. This equipment should be of forged steel and not pressed steel. They should be of 10 or 12 point type and must be securely fitted to the climber's boot. Suitable bindings are essential to properly mount this equipment on the boot.

7. Ice-axe. This item is generally a standard piece of equipment with but minor variations in weight, shape, and size. The critical requirement is that the head of the axe be securely fastened to a strong shaft. A sliding wrist loop must be provided.

B. Special Rescue and First Aid Equipment

1. "Stokes" or Navy type wire basket litter. This has proven to be the most practical litter to use in mountain rescue operations. It provides maximum protection to the injured and maximum ease of handling. To facilitate its movement to the scene of the accident, it may be desirable to sectionalize the litter by cutting it into sections and refitting the ends so the unit may be securely fastened together when the scene of the accident is reached. This permits the stretcher to be carried in two equal sized and equal shaped sections.

2. Wheeled litter carrier. This important labor saver is designed to carry the litter when the trail or suitable terrain has been reached. Various types may be secured but the one-wheeled carrier with a low center of gravity seems to be most desirable.

3. Karabiner brake assembly. The double karabiner brake assembly requires six karabiners of the same type. A device has been developed which effects the same braking action yet only requires two karabiners. Since many rescue operations require a positive friction brake of some sort, the members of the team should become thoroughly acquainted with the potentialities of such equipment.

4. Pulley blocks. This equipment may be desirable in specialized lifting or pulling operations. Their use will be somewhat hampered, however, by the degree of elasticity of nylon ropes used therein.

5. Steel cable and winch assembly. Although this apparatus may have had limited use in this country to date, its practicability for special rescue operations should be determined. Steel cable utilized should be of 5/32 inch or 3/16 inch diameter and sufficient length on the winch assembly to provide optimum utility.

6. Cable ladders. Lightweight and strong cable ladders are now available in lengths of from 30 to 50 feet. These lengths may be joined to provide additional continuous length. Their use may facilitate rescue operations.

7. Avalanche probe poles. A supply of these poles should be available whenever snow and terrain conditions so warrant. One half inch electrical conduit pipe has proven very acceptable for probing.

8. Shovels. Lightweight shovels should be available for shoveling in avalanche situations to recover victims buried beneath the snow.

9. Sleeping bag with full length zipper. A sleeping bag of appropriate weight for weather conditions encountered should be available to provide proper protection and warmth to the injured climber.

10. First aid equipment. Appropriate first aid equipment should be available to handle any mountain rescue

situation. This equipment should be in lightweight containers, preferably canvas rolls. The unit type first aid kit has proven most acceptable although a supply of adhesive tape in rolls may be an appropriate addition to the unit type kit. A leg splinting may be accomplished fairly effectively by using the Navy type wire basket litter. A supply of pain relieving tablets should be carried to alleviate pain on the part of the injured climber. Acceptable pain relievers include Demerol hydrochloride tablets. Check details with local physicians.

C. Clothing and Personal Accessories

1. Boots. Boots should be sturdy and acceptable to the requirements of the terrain. The most universally accepted sole is the rubber-lug sole. Boots may be purchased with this sole already in place or the sole may be added to any good, sturdy climbing boot. Rubber soled sneakers are sometimes acceptable but in no circumstances should any member of the rescue party or support party wear leather soled boots or shoes.

2. Hard hats. Members of the rescue team should be equipped with "hard hats." Many types of protective headgear are available. The principal requirements are sufficient impact strength to withstand falling rocks, and lightness and comfort. The hard hat should be equipped with provision to utilize electric headlights. The hard hat should be fastened to the wearer by means of a chin strap.

3. Rucksacks. Although most members of the rescue team will have their own rucksack, a supply of these should be on hand. Perhaps the most practical rucksack is one with a sturdy metal frame. The principal requirement is that the rucksack be large enough to carry the quantity of equipment usually required on rescue operations and that it be comfortable to the wearer.

4. Packboards. Packboards are required to carry the sectionalized wire basket litter and other bulky items. The preferred type is the contour frame of lightweight metal with full nylon mesh back support.

5. Headlights. Electric headlights for rescue operations are essential. They should be of the type requiring four dry cells, each of which is utilized to

give maximum light. Headlights should be carried by each member of the rescue team on almost every rescue. Even though the team has every reason to believe the rescue may be effected before nightfall, very frequently this is not the case and headlights are usually required.

6. Parkas and warm clothing. Rescues under alpine conditions are subject to cold weather and sudden storms. Members of the team should be equipped with adequate clothing to protect themselves against sudden adverse weather conditions. Clothing carried should be warm, lightweight and water repellent.

7. Gloves or mittens. Each member of the team should be equipped with appropriate protective and warm hand wear.

8. Lightweight tent. Should it seem appropriate, a lightweight bivouac tent should be carried. Should a tent not be required, a light nylon tarp may prove valuable for shelter purposes.

9. Compass. Even experienced climbers have become confused in familiar terrain under dense cloud and storm conditions. A compass should be carried by the rescue leader.

10. Binoculars. Valuable in any search and rescue operation.

11. Camera. To document conditions at the scene of the accident.

D. Communication Equipment

1. Radio. Radio communication between the rescue team leader, the organizational leader, and the support leader is essential. Prearranged contacts should be planned prior to the departure of the rescue team and the support team. Lightweight portable FM radios have proven invaluable in mountain rescue work.

2. Audible signals. Whistles, or Freon powered horns may prove valuable for some search and rescue operations. Prearranged signal codes must be established.

3. Signal mirrors. Directional signal mirrors may prove valuable for location or communication purposes.

4. "Bull" horns. Battery operated hand megaphones are valuable in many search and rescue operations.

5. Colored smoke flares. Prearranged signals utilizing colored smoke may be valuable, particularly in conditions where other means of communication are not possible and in aircraft search coordination with ground parties.

6. Colored panels. Colored signal panels used with prearranged codes are helpful in identifying ground situations to aircraft or distant observers.

E. Food and Water

1. Members of the rescue team should not neglect their own food requirements. Food carried should be nourishing, palatable, and lightweight. The area should have emergency lightweight rations on hand to supplement any personal food carried by members of the team.

2. Canteens with water are required when water is not available en route to and in the vicinity of the scene of the accident. Water and food requirements of the injured climber should be considered also.

3. Primus stove. It may be desirable to carry a small gasoline or solid fuel stove.

CHAPTER 6 EVACUATION PROCEDURES

The purpose of this chapter is to recommend procedures and techniques in the evacuation of injured climbers from all types of rough, mountainous terrain. The type of terrain from which the evacuation of the injured persons may be expected must be carefully analyzed in the formulation of the rescue plan. The nature of the terrain will greatly influence personnel and equipment requirements.

I Nontechnical Evacuation Procedures

Most, if not all, rescue operations will involve a large amount of nontechnical, yet rough and broken terrain. Glacier moraines, talus and scree slopes, and areas of bedrock at low angles, fall in this category. In some respects, this type of terrain presents more arduous problems than the high angle rock and snow. Gravity cannot be used to great advantage and large amounts of manpower are required to perform the hard work of hand carrying.

The procedures described below are the type encountered on virtually all mountain rescue operations. It is essential that all persons called upon to take part in any such operation be familiar with these procedures and the equipment involved.

A. Rigging the Stretcher

Upon the rescue team's arrival at the scene of the accident, and after first aid has been given, the injured climber and the stretcher are prepared for travel. Two or three men should set the stretcher on a roomy, level spot, free of loose rock. If snow can be utilized immediately in the descent, the stretcher bottom should be covered with canvas or other suitable material before the injured climber is placed in the stretcher. This canvas bottom on the wire basket litter facilitates its movement over snow and prevents the snow from working through the bottom of the stretcher. A belay rope should be attached at this time if it is required for the descent.

After first aid has been given as required, the injured is placed in the full length zippered sleeping bag in the stretcher, made as comfortable as possible, and securely tied in place. He must be secure. Tie ropes

should not pass around the bottom of the stretcher as they may be cut or abraded. Tie ropes should be examined frequently.

B. Division of Labor in Carrying

When the members of the rescue party do not need a belay for their own protection, the stretcher very often does. At the same time, the stretcher must be carried and a route must be scouted and cleared. Hence, there are essentially three roles with which each party must be familiar. Twelve men are the optimum number required for hand carrying over normal nontechnical terrain. Six men are required for carrying, two men for belaying, two men for scouting and clearing, and two men to carry surplus equipment. These roles must be systematically rotated.

C. Carrying

The party should first be organized into pairs of men of approximate equal height and weight. A pair will work together on belaying, scouting, or opposite one another carrying. While carrying, one pair will take the foot end of the stretcher, one pair the middle, and one pair the head end. Six men seem to be the optimum number for carrying. With more than three on one side, they interfere with each other's movements. With less than three, each man has too much weight to handle in rough terrain and if one slips, trips, or stumbles, the stretcher may go down. As an aid in carrying, each man should have a web sling. It is hung over the outside shoulder, passed through the stretcher frame, back up over the shoulder and down to where it is held in the outside hand. The weight is thus placed on the shoulders rather than on one hand and arm and the height of the stretcher can be adjusted easily.

D. Scouting and Clearing

Two men should be sent out in front to locate and indicate the best route for carrying through large talus or undergrowth. In addition, they should clear the path of obstructions where possible. These two men may be considered to be in the rest phase of carrying operations.

E. Belaying

Two men will handle the belay rope which trails from the head end of the stretcher. They will operate as a team in leapfrog fashion, one taking over the belay near the stretcher when the belayer runs short of rope. On gentle terrain, as covered in this section of the plan, a sitting hip belay is generally sufficient on rock and a standard ice-axe belay on snow. The belayer should hold a slight amount of weight, more weight where the slope is steep, and less where it is gentle, and pay the rope out in a slow, steady manner. He should locate belay positions which are secure enough to permit holding unusually heavy loads, especially when the stretcher is being moved on snow fields. He must be particularly adept at the ice-axe belay technique. Members of the carrying party should impose as little additional strain on the belayer as possible.

F. Rotation of Roles

In order to minimize fatigue and distribute the work load evenly, a system of rotation is used. First, once pairs have been designated, all relief or change of jobs should be done by pairs. Second, it is the rescue team leader's responsibility to call for a break or relief every 100 yards or every five minutes. As a standard procedure, the relief should be effected from the front to the rear, with the scouting pair taking over the foot end for carrying, the pair at the foot moving back to the middle, and the middle pair moving to the head of the stretcher; the pair at the head will then either take over the scouting role or the equipment carrying role. At the time of such a shift, the pairs remaining on the stretcher may change sides if they desire thus shifting to a different set of muscles. If relieving and shifting is left to the initiative of individual party members, rather than a systematic procedure, the work load invariably falls on some more than others. The team members may not "wear out" evenly and if the trip is long and no additional manpower is available, the leader may choose to shift to a voluntary rotation and relief system. The stronger members of the team may then assume more of the strenuous work on the last leg of the journey.

G. Travel on Trails

Once the trail head is reached, much of the hard work can be avoided by the use of a one-wheeled carrier on which the stretcher is fastened. Two men can operate the wheel with its load--one man takes the front with the job of steering, braking, and keeping the stretcher at a uniform level; the other takes the rear and his main job and most important one is to keep the stretcher centered and balanced over the single wheel and working the brake if a mechanical brake is provided. If the wheeled carrier has a high center of gravity, a third man might be used along the side to assist in keeping the stretcher centered over the wheel.

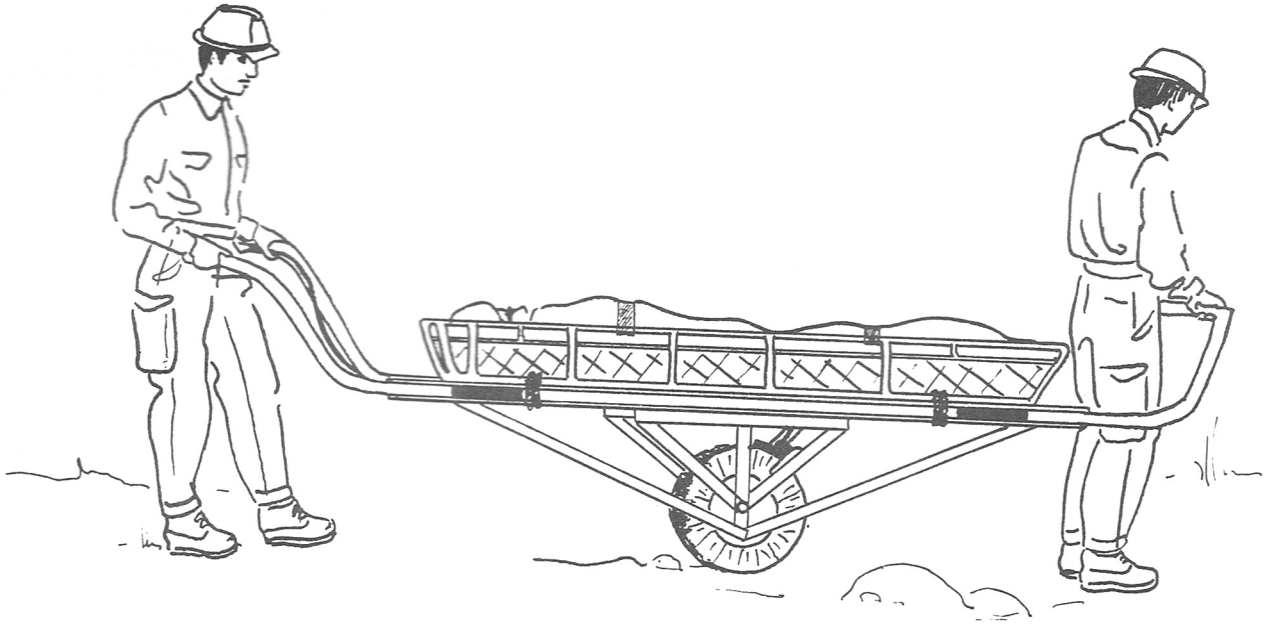
H. Care of the Injured

In all carrying and evacuation operations due regard must be maintained for the condition of the injured climber. The welfare of the injured must be ascertained from time to time and every possible effort made to avoid aggravation of his injuries. He is completely at the mercy of the rescue team and is incapable of helping himself. He must be protected from falling rocks, undue exposure, strong sunlight, and other conditions which may cause him additional discomfort. He must be securely tied in the wire basket stretcher.

II Technical Evacuation Procedures

This section outlines procedures which may be employed in evacuations from areas considered extreme or technical by mountaineering standards.

When the slope is very steep and the terrain generally hazardous for climbing, the stretcher can seldom be carried by six men for more than short distances. In addition, the movements of team members may require rope protection. This, of course, complicates the problems of evacuation greatly. Every additional man in the party is a possible burden, and each member must be thoroughly familiar with general climbing procedures as well as evacuation techniques. Hence, the team must be small in number. Since hand carrying is not possible to any great extent, a large number of persons is neither desirable nor required. A few well trained and experienced members, using equipment to control the force of gravity, can do a better job with greater safety.



An effective one-wheel litter carrier.

The following outline includes anchoring systems; the use of friction for braking; a set of basic maneuvers utilizing such brakes and anchors; and some general principles.

A. Anchoring Systems

The lives of from one to six members of the team may depend upon the strength of anchor points employed in lowering or holding operations. It will, on occasion, be necessary to support the weight of two or three men plus the loaded stretcher and other equipment from such anchors. The time required to set up anchors and other devices is, in itself, an important factor. The terrain must be used to the greatest possible advantage in locating the quickest and strongest anchor points along the evacuation route. In some cases, the route may be partially dictated by the availability of suitable anchors and belay points. The team members must learn to "see" the terrain in terms of anchor points which facilitate the use of gravity in evacuation problems. Every anchor point must be completely "bombproof."

1. Simple Sling Anchor. This anchor is by far the most simple, quickest to install, and most secure of all anchoring methods, provided the rock is sound and the sling well placed. A 20 foot length of 3/8 or 7/16 inch nylon rope should be available. Loop the sling around a large secure boulder, chock stone, or rock knob. Make certain the rope cannot slip off under strain and will not be cut by sharp corners. Sharp rock corners may sometimes be softened with a piton hammer or otherwise padded by clothing items. Place the karabiner brakes, etc., in this sling. Should unusual strength be desired in the sling, a double sling rope should be used whereby two strands of self-equalizing 3/8 inch rope are employed. When a desired evacuation route is located, look for this type of anchor point first.

2. Self-equalizing Piton Anchor. When no rocks suitable for sling anchors are found, and when the route cannot be readily modified to provide such an anchor, pitons must be employed. Everyone, presumably, is familiar with the uncertainties of pitons and the usual absence of adequate piton cracks. It is possible that one piton, an angle piton perhaps, in just the right crack, will provide an adequate anchor - but it is unlikely. If several pitons are employed, they are no better than the best piton alone, unless an equalizing sling system is used. The self-equalizing anchor can be set up with from two to five pitons.

Place the pitons in separate cracks, if possible, and close together, if possible, and place a karabiner in each. Using a long sling rope on the end of an auxiliary climbing rope, tie a large, two loop, bowline on a bight forming one large loop and one small loop. Snap the larger loop into the karabiners in the pitons and place additional karabiners onto the rope between the pitons. Draw these karabiners down and secure them in the smaller loop of the bowline on a bight. If a friction brake is to be attached, tie a bowline loop, or a butterfly knot, in the running end just below the main knot. If the anchor is for a static line, such as in a suspension system, the standing end forms the static line.

Self-equalizing piton anchor.

3. Snow and Ice Anchors. While seldom used, the occasion does arise when it is well to know the method of placing anchors in snow and ice. The self-equalizing anchor can be used substituting ice pitons, in firm blue ice, for rock pitons. On firm snow, ice-axes can replace pitons and their respective karabiners but only if the axes can be driven to the hilt. The simple sling anchor can be used on firm ice if time is taken to sculpture a suitable ice nubbin. On snow, the sling can be attached to a "dead man" made of ice-axes, if proper precaution is used.

B. Friction Brakes

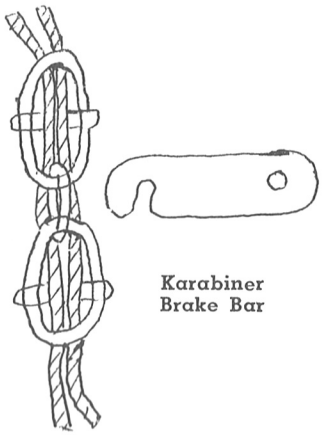
It is often necessary for one man to lower the weight of two or three men. To do this with standard mountaineering equipment, friction is used for braking as in rappelling and belaying. The following brakes are used in conjunction with one of the anchors described above.

1. The Piton Belay. The rope comes from the weight up through a karabiner and down to a belayer who should be anchored for an upward pull. The rope passes down along his inside hip out from the wall under his seat, and up to his braking hand. Note that he is essentially sitting on the rope. He is standing up, wearing gloves, and lowers the weight just as he would belay a leader who has fallen. This simple procedure employs friction over one karabiner and around the belayer's body plus rock friction which may be involved. There is less friction than in any other procedure and hence it is not suitable for extreme weight. If some rock friction is involved, it is usually adequate for lowering a stretcher or one man.

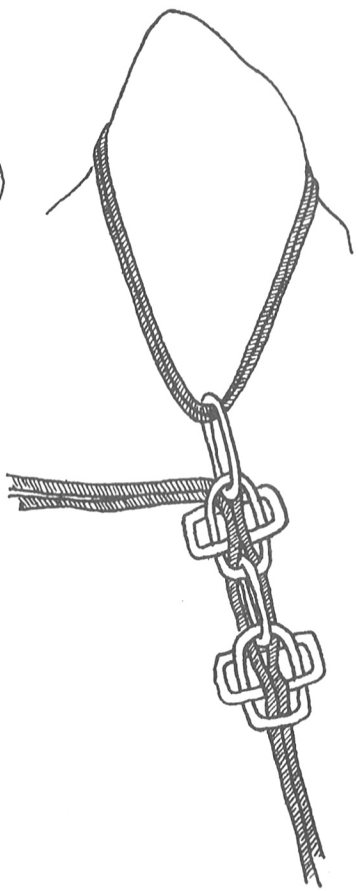
2. Simple Karabiner Brake. The equipment needed is a firm anchor point plus two karabiners. One karabiner is placed in the anchor and the second karabiner is placed across this karabiner to provide the friction bar for the rope. It is essential, of course, that the solid side of the karabiner be utilized for the friction bar. This simple karabiner brake provides but little more friction than a simple piton belay and should not be used to support heavy loads. A karabiner brake bar may be used in place of the second or braking karabiner.

It is important to realize that many improvisions may be made in the use of this simple karabiner brake. For example, the braking karabiner can be replaced by a piton hammer handle or an ice-axe shaft run through the bight of rope.

3. Double Karabiner Brake. The principle and procedure involved in the simple karabiner brake is greatly amplified in this braking system. A verbal description of this brake would be confusing. Learn to set up the brake as illustrated. This brake may be employed with one or two ropes and produces enough braking action to permit one man on belay to handle any weight encountered in rescue work, particularly when two ropes are used.



Karabiner
Brake Bar



Double Karabiner Friction Brake.

Simple Karabiner Brake.

4. Opposing Friction Brake. This brake requires two anchor points, one which is more than adequate for the weight involved and a second strong point. A karabiner is placed in each. The rope coming up from the weight is passed through the karabiner on the stronger anchor, then through the second karabiner on the second anchor and back through the first karabiner again. The rope then goes directly to the belayer who operates it as in the piton belay. The braking action can readily be increased by passing another loop through the second karabiner. The friction is such that most of the weight comes on the first anchor provided it is as high or higher than the second anchor. A single piton will often suffice for the second anchor.

This brake has the advantage of simplicity and adjustable braking power. Its disadvantages are additional strain on the main anchor point; two anchor points are required; more rope is expended in the brake itself; and the rope is subjected to considerable abrasion and fiber damage.

5. Transferring Lines through Brakes. On long descents from one anchor (longer than 110 feet) an additional section of rope must be attached, producing a knot in the line. As any climber knows, such a knot in a running line can cause extreme difficulties if it hangs up or catches on the rocks. Such lengthy drops with standard equipment are, therefore, to be avoided in general. If the route below is known to be free of obstacles which might catch the knot, however, lengthening the rope in this fashion can be a tremendous time saver. It cuts out one or more anchors and the work involved in setting them up.

The problem involved is getting the knot past the braking system while supporting a heavy load. The process of extending the lowering line by an additional section of rope may be accomplished as follows. First, tie the second rope to the first rope before the first rope has passed through the braking system; then attach a sling rope to the first rope below the brake by means of a Prusik knot. The other end of the sling rope is then tied to the free end of the second rope. A second double karabiner brake is established on the same anchor into which the second rope is then placed near its tie to the sling rope. A belayer then holds tension on the second rope while the first belayer lets the weight transfer to the other rope. He then takes the original rope out of the brake, moves back past the

knot on to rope No. 2 and replaces that rope in the brake. The first belayer then holds tension while the second belayer transfers the weight back to him and unties the Prusik sling. It is often necessary to calculate distances to insure that the Prusik knot can be reached after the transfer is completed.

6. Braking on Snow. The principles of braking involved above may be adapted for ice and snow as well. Ice requires no additional discussions since the alteration from rock techniques is largely in the type of anchor involved. On snow, however, it is often possible to combine the anchoring and braking in one operation. On steep, firm snow, place two ice-axes to the hilt about six feet apart along the fall line (see sketch, page 25). The rope from the load makes one turn about the shaft of the lower axe and is belayed with one turn about the shaft of the upper axe. In making the shaft loop, the rope going down the slope should be on the bottom of the turn. The lower axe serves mainly to provide friction. It absorbs load equal to the friction it creates. It need not be manned if it is firmly placed at the proper angle. If the snow will not permit the axe to sink the full length, both axes will require an attendant.

C. Basic Maneuvers in Evacuation

The basic maneuvers in evacuation must be thoroughly understood and practiced as they involve complex combinations of anchors, belays, and brakes. The maneuvers will be described from the simple ones to the more complex and involved. It should be obvious that in selecting routes and employing such maneuvers, those described first should be used whenever possible. Each maneuver represents an attempt to employ gravity to the best advantage in overcoming the problems which the terrain may present. Snow routes are employed whenever possible because they are generally faster and require less manpower.

1. Straight Descent on Snow. Plan the over-all route to maximize straight descent and minimize raising and traversing. The most convenient of all technical evacuation procedures is a straight descent (down the fall line) on steep snow. Tie the belay rope to the head of the litter with a bowline. A standard shaft belay is then taken and the litter is allowed to slide under tension from the belay. One litter man, stationed at the foot of the litter, guides

its descent. When the rope has run out its full length, the litter man anchors the litter by thrusting an axe through the frame and another belayer takes over the rope thus allowing an almost continuous descent. On all snow descents, a pre-cut piece of canvas should be secured to the bottom of the litter to keep snow from accumulating within the frame.

2. Descending Traverse on Snow. The stretcher is rigged with one or two separate belay ropes tied with bowline loops into the uphill side of the stretcher forming an adjustable triangular tie (see sketch, page 16). Three men can control the stretcher on a straight descent or descending traverse over snow. One man accompanies the stretcher and two men operate belays. The belayers leap-frog, traversing above or behind the line of the stretcher. Each belay is simply a static anchor set in advance of the stretcher from which the load is pendulumed to a point below, or permitted to slide free down the fall line. When crossing snow fields or snow couloirs, the traversing maneuver may be combined with the straight descent on snow to arrive at the desired rock landing spot. Rope is simply fed out from the pendulum point to shape the descent as required.

3. Straight Descent on Steep Rock. It is best to follow the fall line on rock as well as on snow. On rock, however, the steeper the angle the easier the descent so far as work and manpower are concerned.

If the nature of the injury will permit, the stretcher is most easily lowered with the feet down at a sharp angle. One belay rope is tied securely into the head end of the stretcher forming a triangular tie. This belay rope must be tied around the main structural member of the wire basket stretcher and not around one of the weaker supporting members. The injured must be securely tied into the stretcher.

An anchor is selected just above a fairly roomy ledge for a loading platform. The belay rope is then secured into a friction brake. One man gets into a seat sling and snaps this sling into a line about 10 feet long which is tied to the belay rope with a Prusik knot. The position of the Prusik is adjusted so that the foot end of the stretcher comes up into the man's lap as he descends beneath it.

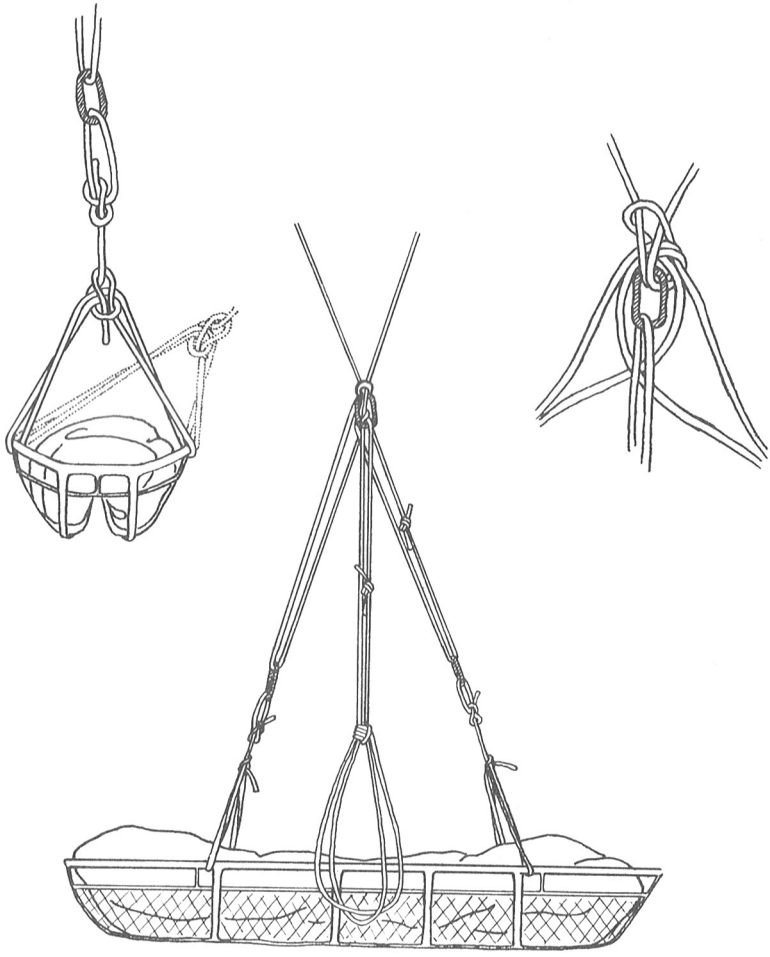
While the above steps are in progress, two men descend to the landing platform, move to a spot protected from rock fall, and wait to receive the stretcher. It may be necessary for these men to go down in advance to establish the suitability of the landing before the route is decided upon. If a rope transfer will be needed, these men will inform those above of this fact and they can proceed to prepare for it. If there are obstacles along the route of descent, which the man with the stretcher cannot manage alone, these "scouts" will recognize this and one or both will be stationed to assist when the stretcher reaches that point.

a. Roles. One or two belayers operate the brake and line transfers if necessary. One man goes down with the stretcher, keeping it stable and preventing it from banging the rock. Two scouts explore the course of descent, assist the stretcher man at obstacles, clear loose rock, receive stretcher at the end of the pitch, and proceed to set up next anchor. Additional manpower should be below. They can be useful as scouts and the fewer men descending above the stretcher the better, as this minimizes the rock fall. Men working with the stretcher cannot readily avoid falling rocks nor can the injured climber in the stretcher.

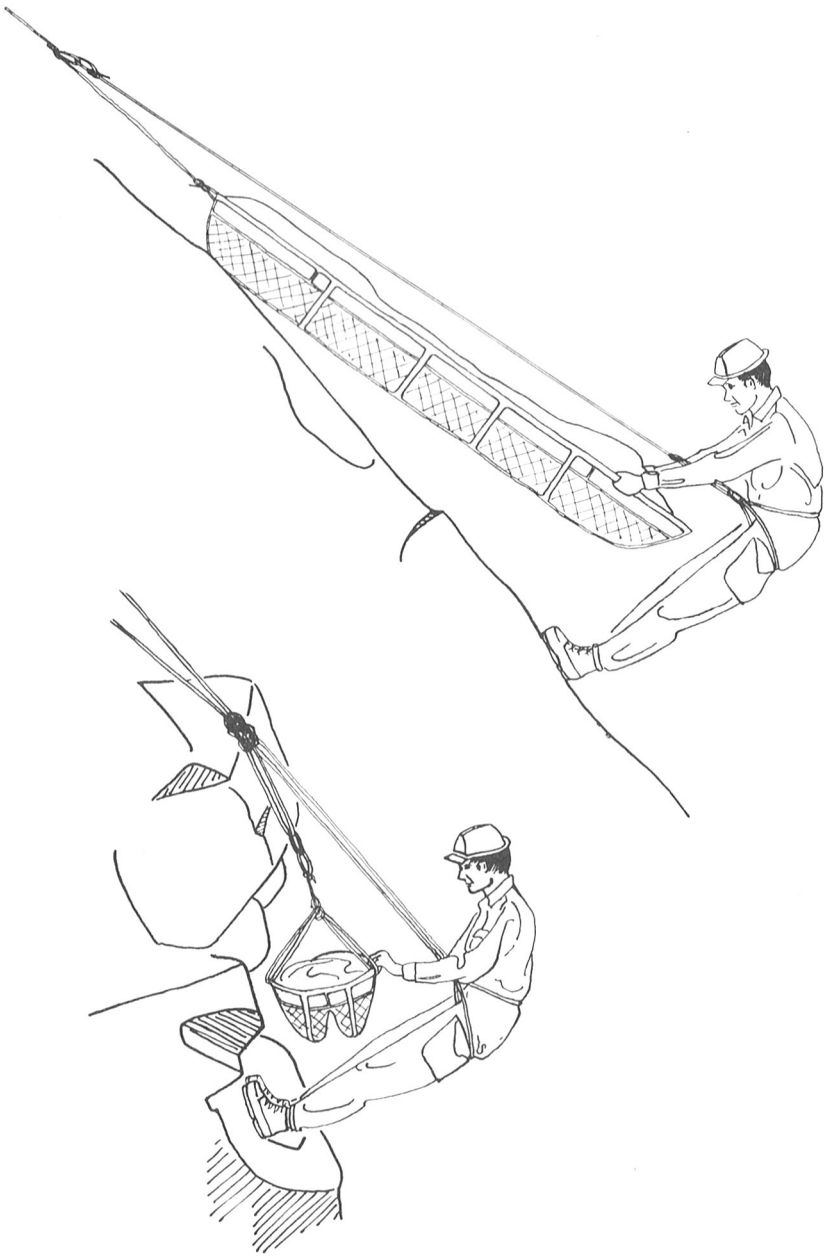
4. Straight Descent on Broken Sloping Rock. For this type of maneuver gravity cannot be used to so great an advantage. More strength is therefore required in moving the stretcher itself. This maneuver resembles the one above with these major exceptions:

The stretcher is lowered horizontally. In rigging the stretcher, two 15-foot sling ropes are used; one is tied with a bowline on a coil at the chest location of the stretcher, and the other is tied with a bowline on a coil at the knee location of the stretcher. The free ends of these two sling ropes are then formed into bowlines. A karabiner is attached to each bowline loop. The belay rope is secured to these karabiners using either a bowline on a coil or a bowline on a bight. The triangular ties may be adjusted by sliding the rope, which passes through the bowline on the coil, so that the stretcher will be level in both directions while being lowered.

The belay rope is secured in a friction brake and the end is tied into the two karabiners on the stretcher,



Stretcher rigging for technical evacuation.



Alternate methods of rigging and lowering stretcher.
(Two stretcher men may be required.)

again using the bowline on a coil to provide a third adjustable triangular tie.

Two stretcher men are used in this maneuver. They are tied to the belay ropes just above the karabiners on each triangular tie, using a Prusik knot and seat slings. The Prusik should be adjusted so that the stretcher is at waist level. These men should be free to swing around so that one is at each end of the stretcher, or to descend side by side along the outer edge of the stretcher with feet against the wall and holding on to the stretcher rim. The stretcher men's weight should be entirely on their sling seats and not on the stretcher.

5. Traverse on Steep Rock. The objective in this maneuver is to utilize gravity to the greatest advantage while traversing on high angle rock faces. Extensive traversing on such terrain is undoubtedly the most severe evacuation problem a rescue party is likely to encounter. As a result, its use should be avoided wherever possible by careful route selection. Even so, the best over-all route is often made possible by this very maneuver and it should be studied and practiced by every mountain rescue team.

The stretcher is rigged as described above, in a horizontal position with two triangular ties. Two belay ropes are tied together forming a 240 foot length. At the middle of this length a large bowline on a bight is used to provide a triangular tie into the two karabiners on the stretcher. Thus, two separate belay ropes are utilized from the same tie in. This two rope system may be used in a straight descent on sloping rock also, with both ropes running through one double karabiner friction brake.

One stretcher man is sufficient if the wall is steep and smooth and only one should be used if possible. He is tied in by means of a seat sling. A karabiner is placed through both loops in the bowline on a bight and a loop of sling rope is snapped into this karabiner. The double sling hanging down is passed through the karabiner on the climber's sling seat and tied back on itself with a Prusik knot. Thus, the Prusik knot is within convenient reach of the stretcher man who can adjust his position as desired. He is normally located in the center of the stretcher although he can move to each end as required.

The maneuver is basically a simple pendulum operation. It starts with the load suspended close under anchor A (figure X) with the belay rope held fast in a friction brake. The second belay rope is now moved forward on traverse and established in a forward anchor B. Once the forward anchor is secured, rope is paid out from anchor A causing the load to be transferred on a descending arc until it is suspended entirely from anchor B. The process is then repeated as conditions require and permit.

Figure X shows this maneuver in diagrammatic form and it should be studied for the several points it illustrates. Notice that anchor A "sends" the load forward starting from a position close under the anchor. As the transfer proceeds, anchor B "receives" the load which is now suspended farther down. These sending and receiving anchors are then repeated in anchors A' and B', etc. The result is a maneuver which follows a generally descending course across the face. As figure X shows, the angle of descent can be partially controlled by the positioning of receiving anchors. When they are placed high and not far forward, the load will descend at a smaller angle.

In figure X, it will be noted that two anchors are required for each pendulum operation; one sending anchor, and one receiving anchor. To save time, the leader may wish to reduce the number of anchors, or a shortage of anchor points may force him to do so. This can be done by using the same anchor point for both receiving and sending functions, thus reducing the required anchor points by one half. When this is done, however, special problems must be anticipated by the leader. Figure Y illustrates the "rope loss" which results when the same anchor is used both to receive the load and to send it on. The distance between anchor point and load progressively increases until finally the sending anchor does not have enough rope to complete the transfer (122' needed in figure Y). The rope can be lengthened, of course, but this will put a knot in the line with all the ensuing dangers.

The "rope loss" just mentioned can be avoided in only two ways. One way is to establish a new sending anchor close to the load. The other way requires hauling up on the load. Figure Z presents the same situation as figure Y to illustrate the use of hauling to avoid rope loss. Notice, in particular, that a truly horizontal course

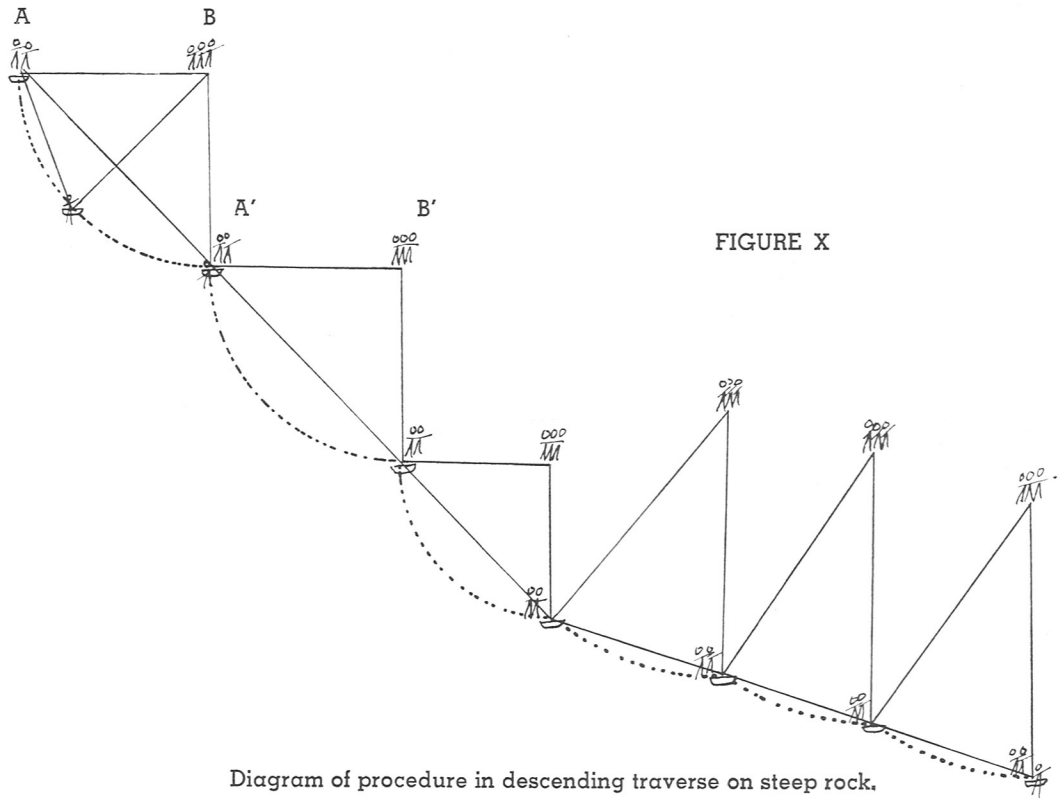
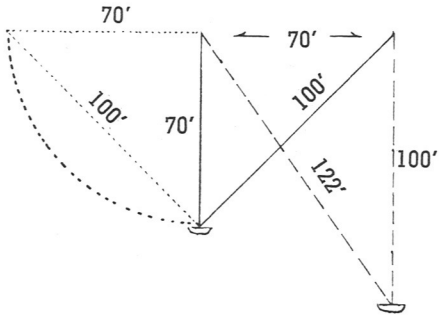


FIGURE X

Diagram of procedure in descending traverse on steep rock.

FIGURE Y

Showing rope loss potential of horizontal traverse.



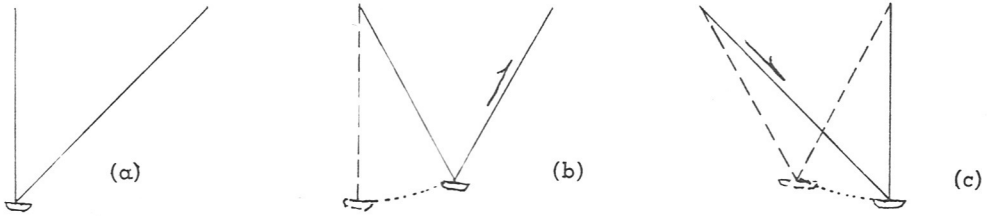


FIGURE Z

Method of avoiding rope loss by raising stretcher while traversing.

can be maintained by pulling the load forward to a point midway between the anchors before slacking off from the sending anchor.

All roles performed by various team members in this maneuver must be thoroughly understood by each member. One man serves as stretcher man. His job is to guide the stretcher and hold it away from the rock. He helps to pull the load forward on the pendulum when a hauling operation is required. Two men act as anchor men. They always handle the sending function when the load is transferred forward and they dismantle brakes and anchors and shuttle equipment forward.

Since lifting or hauling is often required at the receiving anchor, three scouts tend the forward position. Among these three scouts is the Rescue Team Leader and his alternate. The maneuver is planned and directed by these scouts, who must locate and set up anchor points in proper relation to each other. It is important to note that the leader must know where the maneuver will end before it is set in motion. He should have an "anchor plan" formulated in advance; a pattern of anchor locations which will bring the load through the operation with success.

Any hauling that is required will be done by the scouts, usually in one of two ways. One scout may descend almost to the level of the stretcher and through an auxiliary rope-end to the stretcher man. He and the stretcher man can then pendulum the load up to the half-way mark shown in figure Z. When this is not feasible, all three scouts must use the hauling system outlined below to lift the load a short distance toward their anchor point.

The maneuver just described is designed for extensive traversing on very steep rock and is a highly technical problem. Fortunately, the need for such a long traverse occurs rarely. Short traverses, however, will be common in technical evacuations.

Traverses of this type may be necessary on sloping, broken rock faces. The procedure is essentially the same as above with these exceptions: two stretcher men are used as in the straight descent on such terrain; pendulums must generally be very short; the stretcher men can hand carry for very short sections.

6. Raising the Stretcher. The traversing maneuver described above is often successful only if the stretcher is occasionally lifted up. The scouts have the responsibility for this task and should carry equipment for it. Aside from its use in conjunction with the traverse, extensive lifting may be involved in the evacuation route.

a. The load is hanging from an anchor point, toward which it is raised. There should be space enough to permit a climber to descend easily down the belay rope for 15 to 20 feet.

b. A small Prusik sling with a karabiner in it is attached to the belay rope as far down as possible. A second sling is secured to the anchor and tied to the belay rope with a Prusik knot very close to the anchor.

c. An auxiliary rope is tied to the anchor. It then runs down along the belay rope, through the karabiner in the Prusik sling, and up to be hauled upon. One or two men can lift about 300 pounds without much difficulty because of the mechanical advantage.

d. As the load is lifted, another man tends the upper Prusik, drawing the slack up through as the load comes up. When the lower Prusik arrives near the brake, the load is shifted to the upper Prusik while the other one is run back down the rope for another haul.

This procedure uses karabiners for pulleys. The friction is so great, however, additional mechanical advantage is not obtained by the use of more karabiners. If small two-wheel pulleys are available, the work can be greatly reduced.

D. Suspension Systems

Circumstances frequently arise which necessitate the moving or transporting of the loaded litter by suspending it above the terrain. This is often the case in crossing gorges, streams, and steep couloirs. The principal advantage of this suspension traverse operation is that it provides a means of transporting an injured person over otherwise impossible terrain. Disadvantages include the time consumed in rigging, the difficulty of locating proper anchors, loading and landing platforms,

and the additional strain placed on anchors and suspension ropes. The strain on the anchor and ropes greatly exceeds the weight of the injured climber.

1. The Tyrolian Traverse. Most mountaineers are familiar with this device as a means of transporting able-bodied men. When used for transporting a stretcher, the loading and landing platforms must be carefully arranged, particularly the landing. Booms, or "A" frames, are often used to raise the suspension line above such platforms but they are seldom, if ever, available in the high mountains.

a. After two "bombproof" anchors have been arranged, one at each end of the span to be crossed, a 7/16 inch nylon rope is secured at the upper or starting end. The anchors and rope used in syspension traverse systems must have a safety factor of at least ten X.

b. At the lower or receiving end, a butterfly knot is then tied about eight feet out on the rope with a karabiner in the loop. This end of the rope is placed in the anchor through the karabiner and pulled up tight by hand.

c. The stretcher is rigged with triangular ties fore and aft, and joined across at the top. A separate belay rope is tied into each end of the stretcher.

d. If the line is horizontal, the head-end rope is taken across, the triangular ties snapped into the suspension line, and the stretcher goes across feet first. If the line slopes noticeably, the feet go down hill.

The sag in the line can be reduced by using two ropes for the suspension, but every inch of sag taken out of the line transfers greatly amplified strain to the anchors and ropes.

2. The Adjustable Suspension Traverse. This system is a modification of the Tyrolian Traverse. It is much more versatile and is not limited to about 100 feet as is the above system. Much more effective use of the terrain is possible in selecting route and anchor points as well as landing stations.

a. Two anchors are set up and the stretcher is rigged as above, with two belay ropes.

b. A brake is placed at each anchor and the suspension line is set up in the brakes. The line need not be exceedingly tight and the line may be two ropes tied together with the knot as far toward the opposite end as possible.

c. The stretcher is sent out on the line as above and it may be maneuvered to a landing spot anywhere on either wall or in the middle by taking in or letting out on the belay ropes and properly feeding out rope through the brakes on the suspension line.

E. Stresses and Strains

Anyone employing equipment for purposes described in this section should be aware of certain important principles of stress and strain on equipment. Examples are given which serve to illustrate some of these principles.

Consider an anchor with a rope hanging double through a karabiner, with both ends tied to a 100 pound weight. The strain on the anchor is 100 pounds. If one end of the rope is then untied from the load and handed to the belayer, the belayer then absorbs a strain of 100 pounds and the load imposes a strain of 100 pounds, resulting in a total of 200 pounds strain on the anchor. By simply altering the location of the rope in this instance, the anchor strain has been doubled.

Two anchors are placed side by side and a rope is hung from one to the other with a 100 pound load at the bottom. Each anchor then receives 50 pounds of strain if the ropes hang vertically and parallel. If the anchors are separated a few feet so that the ropes form an acute angle down to the load, then each anchor has a strain in a new direction of 50 pounds plus, the amount depending upon the angle of the sling. If the anchors are separated more, forming a very open obtuse angle to the load, each anchor then has a strain far in excess of 50 pounds. As the rope approaches the horizontal between anchors, the load on each anchor increases toward infinity. This simple principle should be kept in mind when setting up rappel anchor slings, piton placements for anchors, suspension systems, belays on the middleman, etc.

F. Summary

The foregoing section on technical evacuation procedures is based upon typical maneuvers and several rather common methods of anchoring and braking. The terrain of course, is never typical and, for this reason, the procedures outlined are by no means a substitute for the climber's ingenuity. These basic maneuvers should be viewed as suggestive rather than final. When the terrain permits, they will work, if properly employed.

Finally, a review of this section should not be considered as adequate training in these techniques. The technical climbers, in particular, should utilize this section in simulated rescue situations. They should work through these maneuvers singly and in combination to convince themselves where and how the procedures work. By far the greatest skill in technical evacuation is required in "fitting" techniques to terrain. Knowledge of the techniques themselves is of lesser importance by comparison.

CHAPTER 7 THE RESCUE PLAN

A. General

The rescue plan must be based on rescue requirements. It must assume adequate personnel and it must assume adequate equipment.

The rescue plan must be an action plan and present definite procedures for definite rescue situations.

The rescue plan must recognize the rescue mission, the possibility of additional emergencies, and the safety and welfare of the members of the rescue team.

Any rescue operation involves persons both in the mountains and in the valley. They are all members of the team and their actions must be coordinated if maximum efficiency is to be achieved. The person in charge of the operation in its largest sense is the organizational leader who is located at headquarters or the base of operations. It is here that most of the organization is handled, the rescue plan placed into operation and the initial rescue crew, as well as later support parties, are assembled, equipped, instructed, and dispatched.

Every person who may be called upon to participate in a mountain rescue operation must be prepared to arrive on short notice with: one personal meal; personal ice axe; crampons; pack or rucksack; shoes (sturdy, with rubber-lug soles); hat which will cover the ears; heavy, warm trousers; heavy wool shirt and sweater; lightweight parka (wind and water repellent); gloves for warmth and wear; and other items he might desire for personal comfort.

B. Information

The implementation of the rescue plan is based upon information. It is imperative that this information be complete and accurate. The basic information required to place the rescue plan into operation should answer the five "W's": WHAT, WHERE, WHEN, WHO, and WHY. This information is obtained from the person or persons who have a knowledge of the accident or incident. For this reason, it is necessary to carefully and thoroughly interview any person reporting an accident. The first requirement is to get the person seated and relaxed (if possible), and

then make a studied effort to relax yourself. Obtain answers in full to the following questions.

1. WHAT. Determine just what did happen. Did the climber fall? Is he stranded? Is he lost? Is he dead? Is he injured? What is the extent of injury?

2. WHERE. Determine exactly where the accident occurred. This is extremely important and the informant should be thoroughly quizzed as to the location. He should identify landmarks and surrounding terrain in connection with the scene of the accident. On which route did the accident occur? Should the accident involve a long fall, the probable location of the body should be determined in relation to the true location of the accident.

3. WHEN. Determine the time the accident occurred and recognize lapsed time.

4. WHO. Determine the name, address, age, sex, weight, and clothing of the person or persons involved in the accident. Determine the presence of other members of the climbing party at the scene of the accident who are uninjured.

5. WHY. Determine the cause of the accident.

Weather. Determine weather conditions at the time of the accident and how such conditions may effect the rescue operation.

The person or persons conducting this interview should be thoroughly qualified to do so and, ideally, should be the organizational leader and the rescue team leader. In all cases, two persons conducting the interview are preferable. The information received should be written out completely and the time of the report documented.

Following receipt of the foregoing information, the rescue plan should be placed into operation, as conditions warrant. The rescue and support teams should be alerted and the necessary equipment assembled. In nearly every instance, the rescue plan should be placed into operation immediately. Only in rare and unusual circumstances is there justification to delay the departure of the rescue team.

Frequently, the person reporting the accident, especially if he was a companion to the injured climber, wishes to accompany the rescue team. This request should usually be denied except in situations where there is uncertainty as to the location of the injured climber. In such cases, the companion might accompany the rescue team at least to a point where he may direct the team to the scene of the accident.

Information must frequently be obtained from the rescue party in progress and from the base of operations to the rescue party. For this reason, every rescue team and support party on the operation should be equipped with a lightweight radio. Before departure, the leader of such teams must arrange times for radio contact. In general, these contacts should not be too frequent. While on the ascent, a contact every half hour would seriously disturb the progress of the climb by unnecessary stops. Whenever possible, the first contact should be timed to coincide with standard stopping points. During these radio contacts, changes in plans and new information can be relayed and further contacts arranged as necessary. If contact is not made, transmit your message in any event and try again thirty minutes or an hour thereafter to establish two-way communication.

C. The Detailed Rescue Plan

THE RESCUE PLAN
(Outline Form)

(Assumes qualified personnel and adequate equipment)

I Objectives and Purpose

To effect mountain rescue operations with speed and efficiency and with due regard for the safety and welfare of all concerned.

II Organization and Personnel

A. Leadership

1. Organizational leader and alternate

2. Rescue team leader and alternate

3. Support party leader and alternate

B. Rescue personnel

1. First rescue team members

List the names of the members selected for this team

2. Second rescue team members

List the men selected for this team

3. First support party members

List the men selected for this party

4. Second support party members

List the men selected for this party

III Equipment

List all available mountaineering and rescue equipment and supplies utilizing the same topic headings as identified in Chapter 5, Equipment, of this handbook. Indicate where this equipment is stored.

IV Rescue Situations

The rescue plan described herein is based upon a classification of rescue situations graded from (1) to (4) in order or urgency (not difficulty) and in two general types of terrain classed as (A) Technical and (B) Nontechnical. Eight situations are thus identified.

1A - Known injury on technical terrain
1B - Known injury on nontechnical terrain
2A - Party missing on technical terrain
2B - Party missing on nontechnical terrain
3A - Party stranded on technical terrain
3B - Party stranded on nontechnical terrain
4A - Known fatality on technical terrain
4B - Known fatality on nontechnical terrain

If a situation involves a known injury, it is classified as a (1) even though a person may be stranded

with the injured climber. Classification (2) is made only after it is virtually certain that the party is out in the mountains under presumably difficult circumstances. Classification (3) requires definite information of the possible whereabouts of a stranded person. Classification (4) must be positively determined. In some cases, a person reporting the accident may not be completely certain that the climber is dead. In short, classification is withheld until thoroughly definite information is obtained and any situation is then classified according to its most urgent aspect. Finally, it is classified as technical if the evacuation route will require mountaineering techniques to complete the rescue.

V Rescue Plans

The eight types of rescue situations described above are presented here as eight different rescue plans. The purpose of these plans is to provide the basic organizational framework for rescue missions of characteristic types, thus minimizing the time and possible confusion which is often involved at the start. It is designed to minimize the amount of thinking required in the rush of getting started. But, most important, it is designed to provide each member of a rescue operation with a more immediate understanding of the scope of the mission, the specific role he will be expected to play, and the manner in which his own actions must be coordinated with the actions of other participants.

Each plan consists of a list of minimum personnel; a list of minimum equipment items, over and above the personal equipment taken on all such missions; the organization of equipment into loads for carrying; the order of arrival of equipment loads at the scene of the accident; and the order of departure, if necessary.

1A - Known injury on technical terrain

A technical operation is one which involves a considerable amount of mountaineering technique on steep rock, snow, or ice. Any rescue situation so classified is likely to be fairly long as well, requiring large amounts of arduous hand carrying. The plan is set up accordingly.

Where a known injury is involved, time is, of course, more important, becoming a major factor of the rescue plan.

A. Personnel

One rescue team consisting of six skilled technical climbers and one support party consisting of six competent mountaineers. Additional manpower may be necessary as conditions warrant.

B. Party Equipment

1. Four belay ropes (7/16 inch x 120 foot nylon).
2. Three climbing ropes (3/8 inch x 120 foot nylon).
3. Assorted pitons as required (30 to 40).
4. Twenty-four karabiners.
5. Three piton hammers.
6. One sectionalized wire litter with accessories.
7. One sleeping bag with full length zipper.
8. First aid material as required.
9. One portable radio per six-man party.
10. Headlights and extra batteries as needed.
11. Rations as needed beyond one meal.
12. Wheeled litter carrier.

C. Individual Equipment

1. Ice-axes as required (One per man).
2. Crampons as required (One pair per man).
3. Eleven rucksacks and one packboard, (for the sectionalized wire litter).
4. One meal (personal).

5. One meal (issued emergency ration).

6. Twelve 20 foot sling ropes (Two per technical climber).

7. Two karabiners per technical climber. These are in addition to the twenty-four karabiners required for friction brakes.

8. Six helmets (one per technical climber).

D. Basic Loads

Each of the following loads is assumed to include individual equipment, sole exception being the wire litter load. The person with this load can carry some personal gear but should be relieved of additional weight. The rest of his load must be carried by an associate technical climber who is going all the way.

1. Sleeping bag, one climbing rope, first aid equipment, six karabiners. Carried in a rucksack.

2. Piton hammer, assorted pitons, six karabiners, one belay rope. Carried in a summit pack or a lightweight rucksack.

3. Radio, one climbing rope, individual equipment of the litter carrier. Carried in a rucksack or packboard.

4. Wire litter and accessories including two 20 foot sling ropes and two karabiners. Carried on a packboard.

5. Piton hammer, assorted pitons, six karabiners, one climbing rope. Carried in a summit pack.

6. Piton hammer, assorted pitons, six karabiners. Carried in a rucksack.

The balance of the equipment, itemized in B and C above, should be carried by the six members of the support who should remain in close contact with the rescue team. The wheeled litter carrier is normally left at the point where it may be utilized to best advantage for the descent. Extra rations are carried by the support party.

E. Order of departure and arrival

On some rescue missions, it may be desirable to send some men farther than others, or to send some in advance of others. When possible, it is desirable for the rescue team and support party to maintain close contact with each other so that equipment carried by the support party may be utilized by the rescue team. When it is necessary to dispatch the rescue team first, the following dispatching procedure must be followed: (1) Six technical climbers and loads number one through number six must leave first and go all the way: (2) Two radios must be used, one with the rescue party and one with the support party; (3) A qualified mountaineer, thoroughly familiar with the route, must be available to lead the support party; and (4) The three remaining belay ropes must start out with or soon be transferred to the advance loads.

When roped climbing is required on the ascent, all belay ropes should be transferred to loads number 1 through number 6. The balance of the equipment carried by the support party will remain with their carriers at the highest nontechnical spot. Loads 1-2, 3-4, and 5-6 will travel as three ropes arriving at the scene of the accident in that order.

The rescue plan just described is organized around a minimum of twelve persons. Six top men constitute the technical rescue team and six thoroughly competent mountaineers constitute the support party.

Since these operations involve continuous arduous performance, sometimes in excess of forty hours, the organizational leader must be alert to the requirement of providing additional rescue team and support party assistance.

1B - Known injury on nontechnical terrain

This plan includes most types of rescues that have little or no technical climbing involved in going to or evacuating an injured person.

A. Personnel

One rescue team of six men, including three who are technically proficient for the type of operation.

One support party of capable and strong mountaineers. Additional support as required, depending upon the location of the accident and other factors.

B. Party Equipment

1. Three belay ropes.

2. One sleeping bag with full length zipper.

3. First aid equipment as needed.

4. One piton hammer.

5. A few assorted pitons and karabiners.

6. One sectionalized wire litter with accessories.

7. One radio with each party.

8. Rations as needed beyond one meal.

9. Headlights and extra batteries as required.

10. Wheeled litter carrier.

C. Individual Equipment

The same as listed for Plan 1A modified to as few as three technical climbers.

D. Basic Loads

1. Sleeping bag, first aid equipment. Carried in a rucksack.

2. Piton hammer, pitons, karabiners, one belay rope. Carried in a summit pack.

3. Radio. Carried in a rucksack or packboard.

4. Stretcher and accessories. Carried on a packboard.

The remainder of the party equipment including lights, rations, belay ropes and wheeled carrier may be distributed

to equalize the loads.

E. Order of departure and arrival

The entire crew of twelve men will normally depart and arrive together since nontechnical terrain is involved. Since all twelve men, however, may not be easily located and assembled and since an injured person is waiting an advance party may be dispatched. This party should include at least three technical climbers plus other readily available personnel. Loads number 1 through number 4 must be carried with the advance party. This advance group will be followed as soon as possible by more manpower, bringing the wheel as far as possible. This support party must be equipped with a radio for contact with the rescue team if they are not traveling as one unit. The support party carries extra rations.

2A - Party missing on technical terrain

The rescue problems proposed under this classification become greatly magnified due to the time element involved of first finding the party and then effecting the rescue. Adequate information may or may not be available to aid in the organization of the rescue. If the party is properly registered and "signed out" the area of search will be greatly reduced. If not, information of the most sparse nature, gathered from concerned friends or relatives, will probably state simply that the person is missing. The less information available, the more comprehensive operations become under this plan.

A. Personnel

Depending upon the terrain to be searched, teams of from two to six technical climbers may be dispatched. As the area of search enlarges to include nontechnical terrain, plans 2A and 2B will become mutually supporting.

B. Party Equipment

1. One climbing rope for every team of two searchers.

2. One radio for every team.

3. Technical climbing equipment as needed.

4. First aid equipment.

5. Headlights, one per man.

C. Individual Equipment

1. Rations beyond one meal per man.

2. Helmets for each man.

D. Basic Loads

The following basic loads are for a two man team operating under this plan. For searches involving more persons, loads should be equalized accordingly.

1. First aid equipment, climbing rope, rations.

2. Radio, piton hammer, pitons, and karabiners.

3. Ice and snow equipment may be added to loads one and two as required.

2B - Party missing on nontechnical terrain

A. Personnel

The number of men utilized for this operation are dependent upon the area to be searched. In general, nontechnical search personnel need only be in good physical condition and familiar with travel through rough country.

Additional details on search operations will be found in Part II of this handbook.

B. Party Equipment

1. One radio per team.

2. Rations beyond one meal per man.

3. Binoculars, if necessary.

4. First aid equipment.

5. Headlights, one per man.

C. Basic Loads

1. First aid equipment, rations, headlight.

2. Radio, binoculars, headlight.

3A - Party stranded on technical terrain

The circumstances which may lead to a rescue operation of this type are somewhat limited. In fact, mountain climbing regulations may be such that a party is likely to be classified as missing before it is discovered to be stranded at some particular spot through some chance observation. As in the past, all such parties are likely to be reported by someone; another climbing party, or members of the same party who were able to reach the valley. Classification under this condition is made only if the party is able-bodied but unable to return from a specified area.

A. Personnel

Six technical climbers more or less, the specific number determined by the number of persons stranded.

B. Party Equipment

1. One climbing rope for every two team members.

2. First aid material as needed for the team.

3. One piton hammer for every rope.

4. Assorted pitons and karabiners.

5. One pack radio.

6. Rations as needed beyond one meal for the team plus rations for the stranded party, including liquids.

7. Extra headlights and batteries, as needed.

8. Extra sling ropes for stranded climbers assuming rappels are necessary.

C. Individual Equipment

Same as in Plan 1A.

D. Loads

All party equipment distributed to even weight.

E. Order of departure and arrival

All personnel will depart and arrive together.

3B - Party stranded on nontechnical terrain

Since this type of situation usually requires nothing but a guide to accompany the party out, all that is needed is a competent person who knows the terrain and sufficient additional personnel to carry the equipment listed in 3A, less climbing gear.

4A and 4B - Known fatality on technical or nontechnical terrain

These two types of rescue operations are identical to their corresponding types 1A and 1B, with the exception that first aid material is reduced to the requirements of the rescue team itself and time is not an urgent factor.

VI Critique

Following the completion of each search and rescue operation, a meeting should be held to review the various aspects of the operation. Those attending should include the organizational leader, the rescue team leader and team, and the support party leader.

Any deficiencies in planning, organization, equipment or procedures should be discussed with the objective being to increase efficiency and safety of future similar operations. Important additional training requirements may be brought to light through these discussions.

The search and rescue plans may be altered or adjusted to incorporate improved methods brought about by these reviews.

VII Liaison

Relatives and friends of the injured or deceased climber as well as representatives of the press

should be accorded courteous and thoughtful treatment. It is of the utmost importance that the "next of kin" of the injured or deceased climber be notified of the accident before such information is given to anyone other than those connected with the rescue operation.

The organization leader will be responsibile for this liaison.

Summary

As stated in the introduction to this section, these rescue plans are intended to minimize the amount of thinking required in getting a party together and on the way. It is obvious, however, that the plan cannot eliminate all such thinking. Thus, its proper use should be as a guide or check list for use both in dispatching rescue teams and in organizing and maintaining equipment in readiness. The plans must be flexible, since the complexity of circumstances involving terrain, type of injury, and time and distance factors, result in a limitless number of rescue situations. The leaders involved must couple their experience and judgment with the rescue plan requirements to place into operation a course of action which will result in the fulfillment of the objective of the plan - to effect mountain rescue operations with speed and efficiency and with due regard for the safety and welfare of all concerned.

PART II

MOUNTAIN SEARCH OPERATIONS

CHAPTER 1 PLANNING

One of the most critical demands of an area's protection organization is the capability of immediately launching a full-scale search operation. Such operations, since they usually are necessary for the preservation of life, are of primary importance and take precedence over all other activities.

Search of mountainous areas including steep, rocky terrain, deep canyons, snow and ice areas, swift water courses, lakes, and dense forests, presents maximum difficulties and requires the ultimate in planning and organization.

Again, the basis of any mountain search plan must be a protection requirement study. Such study should analyze the possibility of persons becoming lost in the area. Visitor activities should be reviewed and associated with the various characteristics of the area involved. A large, densely forested area, for example, traversed by ill-defined trails and with no outstanding landmarks, will suggest the possibility of persons becoming lost in that area. Steep walled canyon country with limited access routes also presents a search potential, as does any rugged mountainous region.

A protection requirement study should consider the following:

1. An analysis of the characteristics of the visitor as to age, experience, and origin.

2. A review of past search operations and procedures used.

3. An analysis of conditions of terrain, cover, and weather which contribute to the creation of search operations.

4. The recreational use made of areas by visitors and the relationship of this use to the occurrence of search situations.

5. The volume of visitor use and its relation to factors that may lead to greater or lesser frequency of search operations.

6. The importance of early recognition of factors that may lead to the occurrence of search situations such as developments which may make hazardous areas more accessible, holiday celebrations with peak crowds, large groups of children, etc.

7. An analysis of the adequacy of signing and directional and informational material and devices.

Protection requirement studies will form the basis for planning operations which should provide:

1. The recognition of all conditions under which a search operation may be necessary.

2. The availability of qualified personnel to effect these operations.

3. The availability of all equipment and supplies to effect any search operation required.

4. The availability of important outside sources of assistance including bloodhounds, aircraft, and manpower.

5. The implementation of more than one search operation at any given time.

6. Continued emphasis on the prevention of conditions necessitating search operations.

Successful planning rests with the capability and experience of the organizational leader. He must be constantly aware of the varying potentials which may develop the need for search operations and he must know the capabilities of those under his supervision. Each employee should avail himself of the opportunities afforded to learn the topographic characteristics of his area and correlate these to the possibility of search situations.

CHAPTER 2 ORGANIZATION AND TRAINING

Planning should be done at the area level to provide a well-trained, well-equipped, and efficient search organization. Procedures should be established to cover any type of search operation necessary at that area and under any weather conditions.

The organizational leader should inventory all available area personnel as to their best utilization in search operations.

Search team leaders should be selected from among the best qualified men. These leaders should be designated for certain types of operations or operations in specific areas or districts, as their qualifications dictate.

Frequently, large numbers of individuals are required who need no special qualifications other than good physical condition, general knowledge of the country, and common sense. The availability of these persons must be determined before a search is needed as often the placing of a large number of persons in a search area immediately will result in success. The delay experienced in trying to assemble a large search party may be tragic.

When the organizational leader has inventoried and assigned all area employees and work crews into his general search plan, he should then inventory other possible sources of manpower as contractor employees and other organized groups in or near the area.

The size of search teams will depend upon the situation and terrain and the number of men the search team leader can effectively supervise. The approximate size and number of teams should be predetermined insofar as possible yet the organization should be kept flexible to permit the blending of teams as conditions warrant.

Training in search operations should be carefully planned to gain the most benefit. Some suggested training activities include:

1. A "dry run" organizational dispatching operation where search team leaders are located and theoretically supplied with crews and equipment to search a given area. This problem involves the logistics of moving team leaders

and members from their work locations, by the fastest means, to the search area and the details involved in setting up a communication network and other equipment requirements.

2. A map exercise involving the gridding of the probable search area and the calculation of distances the lost may have traveled, the designation of search districts by topographic features, the size and number of teams required to effect the search, and the probable equipment requirements depending on the terrain and weather.

3. A field exercise where a member of the staff "loses" himself in a designated area and simulates the actions of a lost person. This involves a realistic search operation where organizational and operational procedures may be practiced.

4. A general conference of the organizational leader and search leaders to discuss search potentialities, procedures, and preventive measures.

CHAPTER 3 EQUIPMENT

Equipment requirements should be geared to the size of probable search area, terrain, and weather and should include communication equipment, arrangements for bloodhounds, and aircraft facilities.

Specialized equipment necessitated by terrain may include ropes, ice-axes, crampons, pitons, karabiners, and other mountaineering equipment; boats, life preservers, underwater search apparatus, grappling devices, marker buoys, pike poles, and similar gear for water searches; horses, compasses, string lines, etc., for search of large areas of forest or brush land.

Equipment necessitated by weather conditions normally will require the provision of cold weather clothing and oversnow equipment including skis and accessories, snowshoes, toboggans or sleds, fire starters, and avalanche probe poles. Special warm weather equipment may include such items as sun helmets and heat tablets.

Personal, or general, equipment for nearly all conditions will include adequate foot wear, packsacks or rucksacks, maps, rations, binoculars, canteens, first aid kits, notebook and pencil, flashlights, headlights, lanterns, and the like.

Communication equipment is vital to any search operation, particularly to the large organization efforts over a broad area. Each team leader should be equipped with a portable radio, if possible, to maintain liaison with other teams and the base of operations. Whistles, portable air horns, signal mirrors, hand megaphones, and air-ground marking devices all may be important to the success of the operation. Aircraft or helicopters with high power loud speakers are excellent communication and search assets.

The organizational leader should establish a communication schedule with all elements of the search organization to maintain the close control required and to recall search teams when the missing has been found. When radio communication is not possible, each element of the search organization should report at designated check points at specified times for further instructions.

Protection organizations should be alert to the value of aircraft in search operations and the availability of such craft should be predetermined and considered in all search plans.

Relatively slow airplanes and helicopters with experienced pilots and observers, equipped with radio communication facilities and loud hailers can cover vast search areas in a short time and are especially well suited to searching relatively open areas and bodies of water.

The person best qualified as to knowledge of the country and the search plan should act as observer and advise the pilot as to specific areas to cover. In addition to radio equipment, the aircraft should contain message drop kits to advise ground parties not in radio contact, or the lost party, of instructions.

Aircraft may be used to drop supplies and emergency equipment to ground parties or the lost party.

Helicopters may effect the pickup and rescue of lost persons or persons swimming or floating far from shore after boating accidents.

One "pass" over a specific search area is not enough as the lost party may not be in a clearing or location visible from the air. Repeated flights over all possible areas included in the search plan will permit the lost person sufficient time to signal in some manner or at least reach a point where he may be seen. Air search for lost skiers or others lost in snow country may be simplified by visible tracks in the snow. Fresh avalanche may also be observed from the air, which may have a bearing on search operations.

Pilot and observer should be aware of the possibility of making a forced landing and should be dressed to cope with a "walkout" situation and carry at least minimum emergency supplies for their own use.

Bloodhounds or other tracking dogs should be utilized whenever possible. Their use should be determined early and the dogs secured and placed in operation at the earliest possible opportunity. Too frequently, dogs are not called until the scent of the lost person has been obscured to the point where their value is greatly diminished. Dogs are

especially valuable in the search for children as, frequently, a lost child will not respond to calls or signals and must be visually encountered.

The source of such tracking dogs must be predetermined and plans made for their rapid transportation to the search area.

CHAPTER 4 SEARCH METHODS

I General

A. Determine positively that a search condition exists.

B. Secure detailed description of subject if possible.

1. Age and sex.

2. State of health, mental and physical.

3. Experience in particular area.

4. Habits and temperament, past history of runaway or disappearance, smoker or nonsmoker.

5. Footgear and clothing last worn, pattern, color, etc.

6. Articles carried or believed to be carried, such as fishing gear, pack, lunch, climbing equipment, etc.

7. Name, temporary and permanent address, and names and addresses of family.

C. Circumstances of disappearance

1. Time and place last seen.

2. Companions, if any, and their location.

3. Planned activities or trips, if any, including routes, etc.

4. Record of recent quarrels or misunderstandings with family or friends.

D. Protect from handling or molestation any used clothing, particularly dirty underwear or socks or shoes of subject. These may be invaluable as scent sources if dogs are used.

E. Protect area of possible search from intrusion as much as circumstances permit, pending establishment of search pattern and procedure.

F. Record in written notes all information received. Don't trust your memory alone.

II Search Methods

Place preplanned search procedures in operation. These may include the following situations and corresponding action.

A. Children lost in campgrounds or development centers.

1. Dispatch responsible personnel to areas of greatest hazard and known attraction to children.

a. Stream and lake shores, ponds and creeks.

b. Construction areas.

c. Caves, gullies, and large boulders.

d. Comfort stations.

e. Densely forested or brush areas adjacent or within area.

f. Bear traps, service buildings, stores, etc.

2. Concurrent with search, area personnel should apprise campers and visitors, particularly those located on perimeter of area or near hazard areas of lost child, along with adequate description. Loud speaker equipment will facilitate this action.

3. Computing probable time and distance factors, set up combination perimeter patrols and search groups to assure subject does not wander out of search area.

4. Direct organized search teams under experienced leadership in detailed search of gridded or otherwise defined subareas within the search perimeter.

5. Provide for most comprehensive communications system possible to channel information to search

direction center and to provide search groups with infomation and instructions from the search direction center.

6. Keep planning one or more steps ahead of search operations in anticipation of failure of first steps taken, such as:

a. Provision for expansion of search area and augmenting search group.

b. Provision for utilizing additional equipment such as: hounds, helicopters, planes, loud speakers, lights, etc.

c. Provision of food, coffee, etc., to searchers.

d. Provision of relief personnel.

7. Arrange for handling of families and friends including accommodations and set up press release information.

B. Adults lost in forested areas.

First follow steps outlined under I General of this chapter.

1. Computing possible time and distance factors in relation to time and place subject last seen and time of report, make determination of initial methods of search to be employed and probable area to be covered. Additional factors that need to be considered in making determination of methods are:

a. Current and forecast weather and the subject's likely period of survival, if unhurt.

b. Density of forest cover and feasibility of aerial observation.

c. Terrain hazards and likelihood of injury, both to subject and searchers.

d. Reasonable egress routes for subject from area last seen and ingress routes for searchers.

e. Availability of trained and experienced manpower and of special equipment.

2. Methods of search selected may be any of the following, or combinations thereof:

a. Ground search by large numbers under experienced leadership, gridding or otherwise subdividing the area for control and thoroughness of search and sending specially qualified teams, possibly by horseback, to check most likely hazard areas.

b. Closing off area to search, except around perimeter, and using bloodhounds, properly provided with scent, from well established starting point subject was known to have been. This type of search should be quickly instituted and employ a minimum number of men.

c. Employment of aircraft, including helicopter, preferably with loud hailer equipment.

d. Ground search by small highly trained and experienced groups.

e. Follow procedures outlined in the section under II-A-3 to II-A-7.

C. Adults lost in precipitous areas.

All of the foregoing instructions may apply to search operations involving a subject lost in a precipitous area.

Obviously, the organizational leader would not want to put a large number of inexperienced searchers in a hazardous precipitous area. Such a search would best be accomplished by teams of qualified mountaineers with suitable equipment. Search zones probably would be best defined by topographic features such as valleys, canyons, cirques, basins, drainages, etc. Intercommunication between these teams is important.

It is more probable that persons lost under these conditions may be injured as a result of falls or may be stranded on technical rock. Experienced men, familiar with the area, would have a good idea where such

terrain is located which would cause possible falls or "hung up" situations.

D. Persons lost on bodies of water.

Frequently, concern is shown when a boating party fails to return as scheduled from a trip on large bodies of water. This is particularly true following severe wind storms.

Search efforts should first determine the size of boat concerned as well as all pertinent details as color, size of engine or outboard, whether boat is capable of floating if capsized, if life preservers were on board, etc. The identity of the passengers should be learned as well as age, sex, physical condition, equipment carried and similar details. Information where the boat was last seen is very important if obtainable.

Immediate air search is recommended with radio communication to patrol boats on the water. Lee shores, into which a disabled boat may have drifted, should be observed as well as islands, bays, and other sheltered waters. Floating objects should be examined. Signal fires and other visual signals should be searched for. Searching aircraft should be equipped with life preservers or ring buoys to drop to persons in the water or clinging to capsized boats.

Search of lakes, when the services of aircraft are not possible, should be accomplished by the fastest possible means. Often boat patrol may be aided by shore parties in vehicles, on horseback, or on foot.

Boats used in searching rough waters must be of adequate length and beam and with ample horsepower to maintain control and headway and outrun rapid following seas. A high bridge is very important to permit maximum visibility. Such rescue boats should be fully equipped with radio, flotation features, life preservers, boat hooks, sea anchors, extra fuel supply, lake maps or charts, compass, searchlights, rations, resuscitator, rope, bailing cans, grappling devices, etc.

Rough weather boat handling is an important training requirement and should be practiced. A worthy training exercise is the throwing overboard of a floatable

seat cushion under rough water conditions while underway and then maneuvering the boat to retrieve to the windward side of the cushion and effecting the pickup.

E. Persons lost in snow conditions.

Immediate search by experienced teams is required here because of the probable condition of the subject in extreme weather conditions and the utilization of visible tracks in the snow before they are covered or obscured by wind and snow. When air search is feasible, the operation may be aided by visible tracks.

Searchers experienced in the terrain features and with a knowledge of possible sheltered areas, should be used. The possibility of the subject being overwhelmed by a snow avalanche should always be considered and known avalanche areas examined for tracks.

As in all other search operations, full information regarding the subject should be secured from all available sources. Important clues as to the plans of the lost skier, or winter traveler, may be thus obtained.

F. Persons lost in desert or prairie areas.

Relatively slow aircraft and helicopters are unexcelled in the search of vast open areas.

Persons lost under these conditions frequently have experienced automobile trouble and have attempted to walk out of the situation, sometimes taking what they believe to be "short cuts" to other roads or highways. Lack of water and heat often contribute to the seriousness of the situation.

Normal search routine where a vehicle is involved is to first locate the car by air search. Examine the car and possible footprints in the vicinity; then undertake a planned air and ground search with intercommunication by radio. Aircraft should be equipped with water and food to drop to the lost party.

Special areas of search should include all sheltered or shaded areas as well as springs or water courses. Ground tracking, with or without dogs, is often effective.

III Search Techniques

A. Safety

Assure, so far as possible, that more stable persons are utilized in search operations and that leaders are selected and instructed relative to their responsibility for the safety of their teams. Provide all possible equipment to insure safety in accordance with terrain and weather conditions.

B. Perseverance

Don't give up too early. There have been amazingly successful searches that have lasted for many days under the most adverse conditions before culmination. The human body is remarkably durable and hope for finding the person alive must not be lost.

C. Tracking

Lost persons leave tracks and this fact should never be ignored. Searchers should cultivate careful observation and interpretation of what they see. This should be coupled with an estimate of where a lost person might wander in different types of terrain.

Stream crossings, muddy or sandy areas, snow fields, scree slopes, and grassy meadows should record the passing of the lost person. The direction in which a few tracks point is an extremely valuable observation. The type of footwear worn by the lost person is invaluable information, especially if an unusual sole pattern or size is evident.

A trained observer, or dogs, should be given first access to a region where it is believed tracks may be found before such tracks are obscured by other searchers.

D. Gridding

Where conditions warrant, such as a dense, level, forest and brush area in which a child may be lost, gridding the search areas with string lines run on compass courses may be the most desirable method of assuring that all ground is covered. The areas between string lines should be painstakingly covered as the lost child may

have crawled under a dense bush for protection.

The organization of such a search should assure the leader that every square foot of ground between string lines is covered and the probability of the lost child entering an area of former search is remote. If such a possibility exists, the area should be patrolled. Only by the assurance that all ground behind him is covered can the leader project the search area further.

Gridding by topographical features is a common method of designating search areas. A team, for example, may be given a search sector bounded on each side by streams or ridge lines, roads or trails. In these cases, especially where streams are involved, it is important that one team be given the responsibility of searching the stream, otherwise the area between the stream banks may be missed.

E. Possible actions of lost persons

If we knew the answer to this element, mountain searches would be simplified. Here, the experience gained in former searches, and the cumulative thinking of experienced personnel, should be fully utilized to formulate search plans.

Lost children naturally stimulate the greatest search effort. These youngsters are helpless and very much out of their element in mountainous areas. They usually lack resourcefulness in finding their own way out and are critically subject to natural hazards. They will not usually respond to calls or signals and sometimes hide in the most remote thicket or cave.

Children have been known to travel long distances across rugged terrain and they often travel uphill. Sometimes barriers such as rivers or streams limit the search area whereas such barriers would not necessarily deter an adult.

Early and full effort searches should be made for lost children.

Lost adults require the normal basic research to determine physical capabilities, experience, etc., which have such an important bearing on search efforts.

A normal physically fit adult would be expected to exercise a reasonable amount of good judgment when he realized he was lost. He could be expected to travel downhill, cross streams on log jams, recognize and use game trails and the like. He may build signal fires or arrange a visible marker for air search. He should respond to audible signals. He would be expected to seek water and shelter if possible; he may seek high elevations to search for familiar landmarks.

Under conditions of panic, his action may become completely irrational. He, like a child, may hide and not respond to signals and calls; he may plunge deeper and deeper into dense forest cover and otherwise compound the difficulty and the degree of the search effort.

F. Summary

The moral and humanitarian considerations in the preservation of human life take precedence over all other operations. The immediate response of protection personnel to situations involving lost persons is expected.

Search operations in mountainous areas pose unusual protection requirements which should be met at the highest level of capability. Plans should be made accordingly.

Notes